Cumulative Cost Assessment for the EU Chemical Industry

Final Report

Written by: Nikos Maroulis, Pierre de Kettenis, Kastalie Bougas, Julien Ravet, Alasdair Reid, Julia Rzepecka (VVA)

April – 2016

technopolis | group |

EUROPEAN COMMISSION

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs

Directorate D—Consumer, Environmental and Health Technologies

Unit D2 — Chemicals

E-mail: GROW-D2*@ec.europa.eu*

European Commission
B-1049 Brussels

EUROPEAN COMMISSION

Cumulative Cost Assessment for the EU Chemical Industry

Final Report

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs

2016

Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*)**:**

00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

More information on the European Union is available on the Internet (http://www.europa.eu).

Luxembourg: Publications Office of the European Union, 2016

ISBN:978-92-79-53493-5

doi:10.2873/649728

Printed in Belgium

PRINTED ON ELEMENTAL CHLORINE-FREE BLEACHED PAPER (ECF)

PRINTED ON TOTALLY CHLORINE-FREE BLEACHED PAPER (TCF)

PRINTED ON RECYCLED PAPER

PRINTED ON PROCESS CHLORINE-FREE RECYCLED PAPER (PCF

Executive Summary

Objectives and scope of the study

The aim of this study is to analyse the cumulative costs of the most relevant EU legislation with a bearing on the chemical industry in the 28 EU Member States during the period 2004-2014. Specifically, the study objectives are to:

- provide for quantification of the cumulative costs related to those packages of EU legislation with the highest cost impact, and quantify the cumulative costs in the subsectors of the chemical industry;
- demonstrate how the costs have changed over time;
- compare the costs with relevant financial indicators for the chemical industry.

The study covers the whole chemical sector, although cost is assessed only for the subsectors for which the available data are sufficient to produce reliable estimations. These are, according to the statistical classification of economic activities in the European Community (NACE): 20.13 — inorganic basic chemicals; 20.14 — organic basic chemicals; 20.16 — plastics in primary forms; 20.20 — pesticides and agrochemical products; 20.41 — soaps and detergents, and cleaning and polishing preparations; 20.30 — paints, varnishes and similar coatings and 20.59 — other chemicals products.

Among the pieces of legislation affecting the EU chemical industry, only those incurring high cost directly to chemical companies are included. Legislation that affects upstream non-chemical companies, which then pass on costs to the chemical industry through the prices of inputs, is not within the scope of the study. Similarly, indirect costs — such as opportunity cost due to forgone business or transaction cost and costs related to national legislation exceeding EU requirements — are not taken into account.

Methodology

As opposed to other methods assessing the costs of policies, the Cumulative Cost Assessment provides a quantitative assessment of all costs (monetary obligations, capital expenditure, operating expenses and administrative burden) incurred by EU chemical companies with regards to the EU legislation most relevant to them. This study does not assess the benefits of EU legislation and does not aim to provide insights related to the proportionality of costs and benefits of legislation, nor its efficiency or effectiveness.

The methodology of this study draws on previous similar exercises such as studies on the cumulative cost assessment of aluminium and steel industries, and on methods used by the European Commission and Member States such as the 'Standard Cost Model', or the 'Cost-driven Approach to Regulatory burdens' (CAR) developed for the Dutch Government.[1]

To facilitate the collection of data and the estimation of costs, the pieces of legislation have been grouped into seven packages on the basis of their overarching and specific policy objectives as follows: chemicals, energy, emissions and industrial processes, workers' safety, product-specific, customs and trade, and transport legislation.

Data collection in the current study did not rely on statistical methods. Detailed data were collected from a panel of 31 typical companies[2], which were selected according to a set of criteria. The estimated costs for this panel of companies were validated in two workshops with industry experts and stakeholders. Then the data were adjusted based on the results from an online survey that addressed a larger sample of 90 companies. The results from the online survey appeared to be in line with the cost figures provided by the panel companies, supporting the premise that the initial panel consisted of typical firms. Finally, the data were grossed up to represent the whole population of each subsector by multiplying the turnover of each subsector by the adjusted cost per turnover of the typical companies of the sub sector. The grossing up by using multipliers that represent the whole population of a particular group relies on the hypothesis of full compliance, which however is not always the case. Therefore, in certain cases, it could lead to an

[1] CEPS (2013a). *Assessment of Cumulative Cost Impact for the Steel Industry: Final Report*. Retrieved from http://ec.europa.eu/enterprise/sectors/metals-minerals/files/steel-cum-cost-imp_en.pdf;
CEPS (2013b) *Assessment of Cumulative Cost Impact for the Steel and the Aluminium Industry: Final Report Aluminium*. Retrieved from http://www.ceps.eu/system/files/final-report-aluminium_en.pdf;
CEPS (2013c). *Assessing the cost and benefits of regulation*. Retrieved from http://ec.europa.eu/smartregulation/impact/commission_guidelines/docs/131210_cba_study_sg_final.pdf;
European Commission. (n.d). Standard Cost Model (SCM). *Reducing Regulatory Burden*. Retrieved from http://ec.europa.eu/smart-regulation/refit/admin_burden/scm_en.htm;
European Commission. (2015a). *Better regulation "toolbox"*. Retrieved from http://ec.europa.eu/smart-regulation/guidelines/docs/br_toolbox_en.pdf;
Network Standard Cost Model. (2005). International standard cost model manual. *Measuring and reducing administrative burdens for businesses*. Retrieved from http://www.oecd.org/regreform/regulatory-policy/34227698.pdf;
SIRA. (2015). *CAR methodology manual: A method for identifying regulatory burden within a sector*. Dutch Ministry of Economic Affairs. Retrieved from https://www.government.nl/binaries/government/documents/reports/2015/05/12/car-methodology-manual-a-method-for-identifying-regulatory-burden-within-a-sector/11052015-car-methodology-manual-def.pd.

[2] The term 'typical company' is used in European's Commission's guidelines (e.g. The Better regulation toolbox) and in other established methodologies. A typical company is not an average firm in statistical terms but rather one that is neither particularly efficient nor inefficient in terms of complying with the legislation.

overestimation of absolute values by assuming that all companies fully comply with the legislation.

Despite its significant advantages regarding feasibility, the method is less accurate when compared to statistical methods, and it can only provide an estimate of the order of magnitude of cost borne by companies due to EU legislation.

National legislation that is not related to EU legislation is excluded from the study. Companies participating in the panel and the online survey were therefore asked to report only the costs associated with the requirements set out in the EU legislation. However, in the case of energy taxes a distinction between the costs generated by the EU policy and those by the national legislation was not possible. Therefore, the estimated cost in this case includes also the effects of national legislation.

In addition, to the selected subsectors, a rough picture of legislation's effects on the wholesale costs of chemical products (NACE 46.75) is presented, based on information collected during the study.

The European chemical industry within the study context

The EU chemical industry covers five main sectors (petrochemicals, polymers, basic inorganics, specialties and consumer chemicals) broken down into 16 subsectors. Five of these subsectors (paints, varnishes and similar coatings; printing ink and mastics; soap and detergents, and cleaning and polishing preparations; perfumes and toilet preparations; plastics in primary forms; and other organic basic chemicals) account for over 65% of EU chemical companies (Eurostat, 2015).[3]

The sector is also characterised by geographical concentration, as about 76% of EU chemical companies are located in only seven EU countries: Italy (16%), Spain (12%), Germany (11%), France (10%), the United Kingdom (9%), Poland (7%) and the Czech Republic (6%). Moreover, seven countries — Germany (30%), France (14%), the Netherlands (10%), Italy (10%), Spain (7%), the United Kingdom (7%), and Belgium (7%) — accounted for 85% of EU turnover in the chemical industry in 2012.[4] A similar pattern of concentration is visible by subsector, with 73% (2012) of EU chemicals turnover generated by six subsectors: organic basic chemicals, plastics in

[3] Eurostat, Structural Business Statistics, Annual detailed statistics on industry, (sbs_na_ind), September 2015

[4] Idem

primary forms, paints and coatings, inorganic basic chemicals, perfumes and toilet preparations, and soaps and detergents.[5]

The subsectors included in this cost assessment represent 79% of the turnover of the EU chemical industry, 73% of its value added and 70% of its employment.

Main findings of the cumulative cost assessment

When all legislation relevant to chemical companies is cumulated, the estimated average annual total direct cost borne by the subsectors covered by the study during the period 2004-2014 approaches €9.5 billion, representing around 2% of their turnover and 12% of the value added. Comparing cost with Gross Operating Surplus (GOS), which can be used as a proxy for profit, the cost represents as much as 30% of this value, indicating that legislation cost is among the important factors shaping the profitability of the EU chemical industry.

In addition to the estimated cumulative cost, companies also bear indirect legislation costs, passed on to them through feedstock and other inputs (e.g. electricity or machinery). The opportunity costs due to the withdrawal of substances or the loss of markets may also be important. Although companies raised the issue of indirect cost during the interviews, no robust assumptions could be made for estimating the relevant costs based on the provided qualitative information.

Among the legislation packages, the emissions and industrial processes package represents approximately 33% of the regulatory cost (4% of the subsectors' value added), the chemicals package 29% (3.5% of value added) and workers' safety 24% (2.9% of value added). The contribution of the other legislation packages to the overall regulatory cost is much smaller. The share of the energy package is around 9% (1.1% of the value added), transport 3% (0.3% of value added), product-specific 1% (0.2% of value added) and customs and trade only 0.4% (0.05% of value added). Although the other reported figures do not include costs associated with national legislation, the estimation of the energy taxes cost, which represents 69% of the energy package, does contain the contribution of national legislation.[6]

The variability of costs across the different subsectors, as illustrated in the following figure, is significant and reflects not only differences in product

[5] Idem

[6] As part of the initiatives implementing the Energy Union, the European Commission is preparing a report on the development and implications of energy prices and costs. The report is expected to be presented before the summer 2016. It will investigate the determinants of energy price formation, including the role of energy taxes and levies.

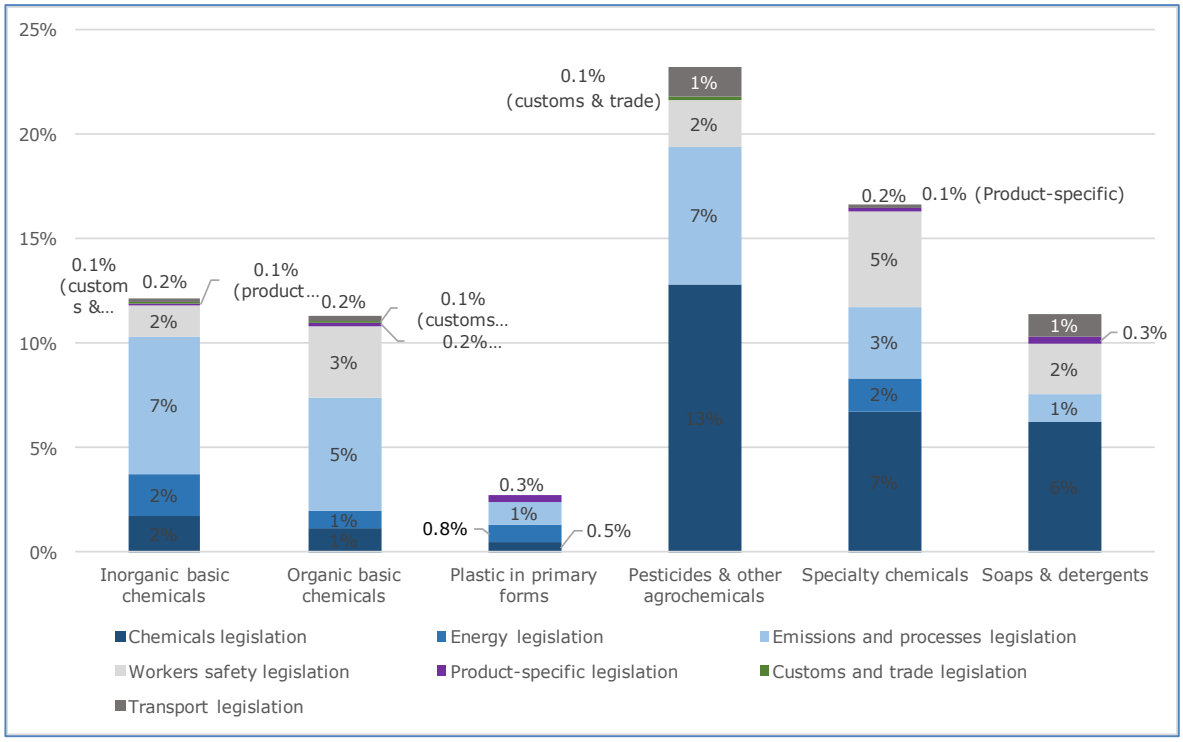
groups and their production chains but mainly differences in the anticipated impact of each subsector on health and safety (of both consumers and employees), and the environment. Thus, the higher cost as a percentage of value added is observed in pesticides and other agrochemicals, amounting to 23.2%, and the lowest in plastics, at 2.7%. The cost for specialty chemicals represents 16.7% of the subsectors' value added, for inorganic basic chemicals the cost amounts to 12.1%, for organic basic chemicals it is 11.3%, and for soaps and detergents 11.4%.

Within subsectors, variability reflects the size of companies and their organisational structure, efficiency, level of integration and product portfolio. SMEs in general incur higher costs compared to large organisations because the costs to comply with legislation are not linear and cannot be amortised on a large volume of chemicals.

Administrative burden is mainly related to the cost of the preparation and submission of information for registrations and the issue of permits, as well as for the information of product users (e.g. labelling), while it does not include the associated monetary obligations (e.g. fees for registration, permits or certification). Overall, it amounts to 10% of the total regulatory cost. Although administrative burden is the smallest cost category, it affects all subsectors. The highest administrative burden is observed in soaps and detergents, where it represents almost 28% of the legislation cost and 3.2% of the subsector's value added. Pesticides also bear a relatively high administrative burden, representing 14% of their regulatory costs and 3.2% of their value added. It is less significant, but with a share higher than average, for specialty chemicals, amounting to 12% of the regulatory cost, equivalent to 2% of the value added. This cost is mainly driven by the chemicals legislation package, which is responsible for 75% of the administrative burden, and more specifically by the legislation related to REACH, Plant Protection Products (PPPs), Biocides and Classification, Labelling and Packaging (CLP). However, a noticeable reduction of administrative burden is expected in the future, due to the final registration deadline for REACH in 2018.

Monetary obligations amount approximately to 20% of the regulatory cost. They include mainly taxes, levies, charges and registration fees. The latter contributes to the financial viability of the monitoring and enforcement system by covering part or all of their costs (for example, REACH registration fees cover the cost of maintaining the REACH registration and monitoring system). Out of all monetary obligations, those stemming from the chemicals legislation package, representing 7% of the total cost, are related to the sustainability of the enforcement and monitoring system. The remaining monetary obligations (representing 13% of this type of costs) are linked directly to energy and environmental policy objectives (taxes and allowances related to the Emission Trading System).

Cumulative cost per subsector and its composition by legislation package – annual share of value added 2004–2014



Source: Authors' elaboration

When restricting the focus to the chemicals package, the highest monetary obligations cost is observed in pesticides and other agrochemicals (25% of the cost), specialty chemicals (8% of cost) and inorganic basic chemicals (7% of cost). The pieces of legislation generating the highest monetary obligations are REACH, PPPs and biocides. Again, as in the case of administrative burden and monetary obligations, a reduction is expected after 2018 in the costs due to REACH.

Capital Expenditures (CAPEX) and Operating Expenditures (OPEX), representing the highest portion of the legislation cost (approximately 71%), affect all subsectors and are mainly driven by the emissions, chemicals and workers' safety legislation packages. CAPEX and OPEX generated by the emissions and industrial processes package aim at reducing emissions and at complying with the best available technique principle. They represent 3.2% of the value added and 27% of the total legislation cost. CAPEX and OPEX driven by the workers' safety and health package aim at increasing the safety conditions and protection of workers. They represent 2.9% of the value added and 24% of total cost. The CAPEX and OPEX generated by the chemicals legislation are mainly driven by CLP and represent 1.7% of the value added and 14% of the total legislation cost. However, similar to REACH registrations, a significant reduction in the costs related to CLP can be expected after the final deadline in 2017.

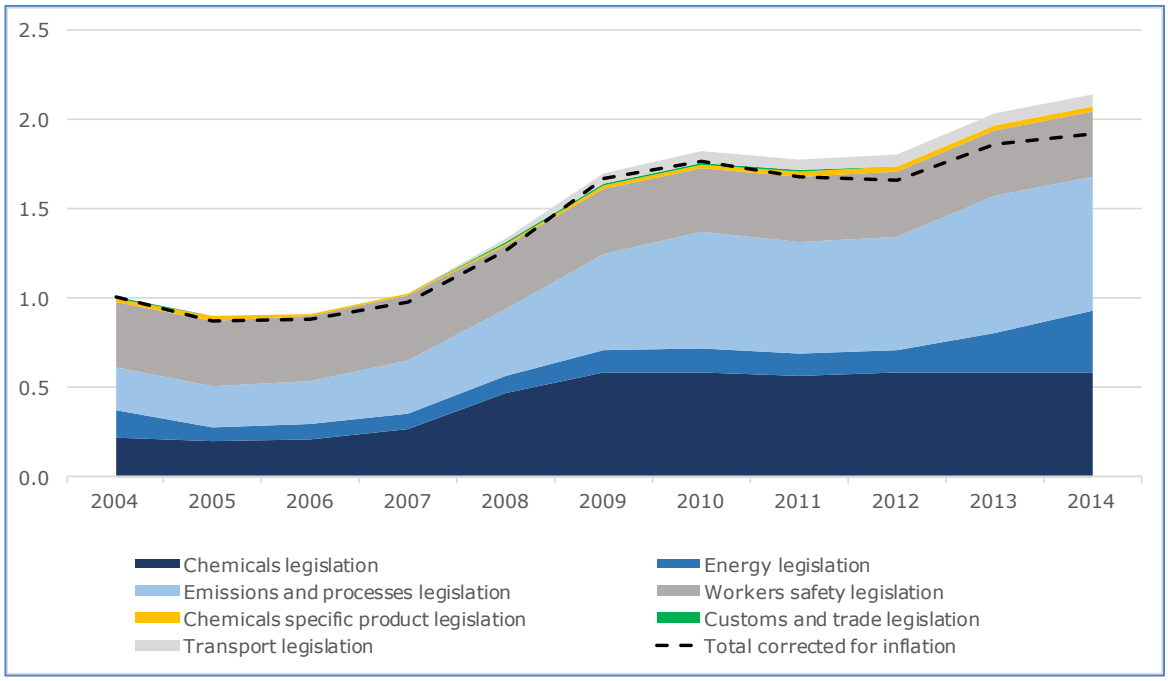
Changes in the classification of substances published in Adaptations to Technical Progress (ATP) affect the compliance of companies with several

legislation packages, requiring additional investments or generating administrative burden. When frequent changes in classification affect the same family of products or the same subsector, the economic impact on the value added can be significant. Classification changes are difficult to predict and, therefore, ex-ante impact assessments fail to consider them in their estimation of cost. CAPEX and OPEX are also often overlooked by impact assessments that mainly focus on administrative burden and monetary obligations that are easier to estimate.

An attempt, presented in the following graph, was made to interpret the evolution of legislation burden by estimating the changes of cost as a percentage of turnover. However, this estimate has to be interpreted with caution, as this is an estimate of the trend based on the extrapolation of data from a limited number of typical companies and their recollections of past costs. Therefore, information about the most recent years is more accurate than about the earliest years of the examined period, as it is demonstrated by comparing collected data with Eurostat data for CAPEX and OPEX for environmental protection. However, direct comparison is difficult due to different definitions and assumptions about the costs. Comparing the data series of Eurostat with the evolution of cost of the emissions and industrial processes package, which is the most relevant to Eurostat data, there are clear differences in the period 2004-2007, where Eurostat data presents a declining of cost. However, for the period after 2008 both data sets demonstrate a similar trend, namely an increase during the period 2008-2010 followed by a period of stability.

The major milestones of the evolution of cost is the introduction of REACH and CLP in 2007 and 2008 respectively (affecting the cost of chemical legislation) and investment by companies after 2009, in anticipation of the enforcement of Seveso III in 2012 and ETS Phase 3 in 2013. Energy legislation also contributes to costs, especially after 2012. One can expect that CLP and REACH costs will decrease after 2017 and 2018 respectively, while cost of compliance with Biocides and PPPs will continue to expand. Costs of compliance with workers' safety and transport legislation should remain stable.

Evolution of cost over the period 2004–2014 — Index 2004=1



Source: Authors' elaboration

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ADR	Agreement on transport of dangerous goods by road
ATPs	Adaptations to Technical Progress
BAT	Best Available Technic
BAU	Business as usual
BREF	BAT Reference Documents
CA	Competent Authority
CAPEX	Capital Expenditures
CBA	Cost Benefit Analysis
CCA	Cumulative Cost Assessment
CEFIC	European Chemical Industry Council
CLP	Classification, Labelling and Packaging
ECHA	European Chemicals Agency
EINECS	European Inventory of Existing Chemicals Substances
ETS	Emission Trading System
IED	Industrial Emission Directive
IEP	Integrated Environmental Permits
IO	Information Obligation
IPPC	Integrated Pollution Prevention and Control
IPPCD	IPPC Directive
JRC	Joint Research Centre
ELVD	End of Life Vehicle Directive
EQS	Environmental Quality Standards
MRV	Monitoring, Reporting and Verification
NEC	National Emission Ceilings

OPEX	Operating Expenditures
OSHA	European Agency for Safety and Health at Work
PPPs	Plant Protection Products
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RoHS	Restriction of Hazardous Substances
SEA	Socio-Economic Analysis
SIEF	Substance Information Exchange Forum
SME	Small and Medium-sized Enterprises
TOR	Terms of Reference
VOC	Volatile Organic Compounds

1 Introduction

1.1 Objectives of the study

The aim of this study is to analyse cumulative costs of the most relevant EU legislation that the EU chemical industry has to bear. Specifically, the study objectives are to:

- provide for quantification of the cumulative costs related to those packages of EU legislation with the highest cost impact and quantify the cumulative costs in the subsectors of the chemical industry;
- demonstrate how the costs have changed over time;
- compare the costs with relevant financial indicators of the chemical industry;

In order to achieve the objectives, the project validated and refined the methodology of the CCA to the specificities of the chemical industry taking into account the experience from the steel and aluminium cumulative cost assessments (CEPS, 2013a and CEPS 2013b), the European Commission's guidelines and methods used by Member States.[7]

1.2 Scope

The CCA is based on a matrix covering subsectors of the chemical industry based on NACE Rev.2 categories (Eurostat, 2015a), as well as selected pieces of EU legislation affecting specifically the subsectors of the chemical industry along the production chain. The matrix approach is used to estimate the costs generated by each piece or group of EU legislation per subsector of the chemical industry.

More specifically the scope of the study is defined as follows:

- **Sectors:** The whole chemical sector is covered, although data are presented only for **seven** subsectors for which the available data are sufficient to produce reliable estimations. These are, according to NACE classification: 20.13 — inorganic basic chemicals; 20.14 — organic basic chemicals; 20.16 — plastics in primary forms; 20.20 — pesticides and agrochemical products; 20.41 — soaps and detergents, cleaning and polishing preparations; 20.30 — paints, varnishes and similar coatings and 20.59 — other chemical products. **Subsectors 20.30 and 20.59 are grouped together into one subsector named *specialty chemicals*.** Therefore, the above six subsectors will be used for the estimation of the cost.

[7] For more details, see the description of the methodology in Chapter 3.

- **Legislation:** All pieces of legislation incurring high cost directly to chemical industry are included. Legislation that affects upstream non-chemical companies, which then pass on costs to the chemical industry through the prices of inputs, is not within the scope of the study.
- **Timeframe**: legislation active during the period 2004-2014 even if repealed or amended within this period.
- **Geographical coverage**: 28 EU Member States.

1.3 Structure of the report

The report is structured in five chapters. **Chapter two** provides a broad overview of the chemical sector. The intention is to provide factual information on the structure of the sector that allows the reader to put the assessment of legislation cost into perspective. Thus, the main characteristics and demographics of the sector are presented together with an overview of the production chain and the cost structure of the sector.

Chapter three presents the methodological approach and defines the boundaries compared to other exercises, such as impact assessment and cost-benefit analysis. The cost categories used in the study are explained as well as the methodology for the selection of the relevant legislation. Finally, the methodology for the assessment of cost is explained. More details on specific methodological aspects are presented in the Annex.

In **Chapter four** an overview of the selected pieces of legislation grouped into legislation packages is presented. The chapter provides a short overview of each legislation package and focuses more on the types of cost incurred by legislation to the industry.

The results of the cost assessment are presented in **Chapter five**. This chapter provides an overall picture of the cost as a total and for each legislation package and subsector. The evolution of the cost over the period 2004-2014 is estimated and presented as a total for the analysed subsectors. The cost is presented by legislation package as a share of value added, gross operating surplus (which is used as a proxy for profit), and revenue. Also for each legislation package the different types of cost are presented. Finally, differences of cost between SMEs and large companies are discussed, although only at the aggregate level.

2 Panorama of the EU chemical industry

This chapter sets the scene for the analysis of the regulatory cost by providing a broad overview of the EU chemical sector without entering into the discussion of sector performance and competitive position vis–à–vis the main competitor countries. This overview defines the boundaries of the sector and provides a picture of its structure, as well as setting out the main key indicators that are important for putting regulatory cost into a meaningful perspective.

2.1 The EU chemical industry

This section provides a comparative overview of the EU chemical industry covering geographic and sectoral distribution. For a better understanding of the differences between the subsectors in terms of size, dynamics and their contribution to the European economy, basic indicators — including investments, personnel costs, employment, turnover, production and added value — are presented.

The chemical industry covers three main categories of products: basic chemicals, specialty chemicals and consumer chemicals. Several categorisations have emerged that break down the chemical industry further. To ensure consistency with the available data, however, subsectors mentioned in this study are reported according to the Eurostat NACE classification (rev.2), as presented below (Figure 1).

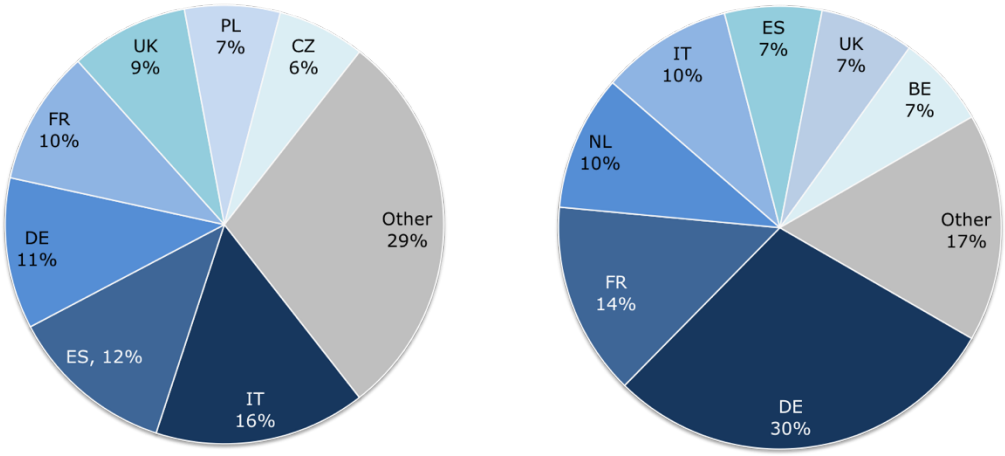
Figure 1: Eurostat classification of the chemical industry

C201: Basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	C20.11: Industrial gases C20.12: Dyes and pigments C20.13: Other inorganics basic chemicals C20.14: Other organic basic chemicals C20.15: Fertilisers and nitrogen compounds C20.16: Plastics in primary forms C20.17: Rubber in primary forms
C202: Pesticides and other agrochemical products	C20.20: Pesticides and other agrochemical products
C203: Paints, varnishes and similar coatings, printing ink and mastic	C20.30: Paints, varnishes and similar coatings, printing ink and mastic
C204: Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	C20.41: Soap and detergents, cleaning and polishing preparations C20.42: Perfumes and toilet preparations
C205: Other chemical products	C20.51: Explosives C20.52: Glues C20.53: Essential oils C20.59: Other chemical products not elsewhere classified
C206: Man-made fibres	C20.60: Man-made fibres

Source: Eurostat, RAMON metadata server, 2016

The EU chemical sector is characterised by **geographical concentration,** as about 70% of chemical companies are located in only six EU countries: France, Germany, Italy, Spain, Poland and the United Kingdom (UK). Similarly, seven countries accounted for 85% of EU turnover in the chemical industry in 2012, led by Germany (30%).

Figure 2: Share of EU chemical companies (left) and share of turnover (right) by country —2012

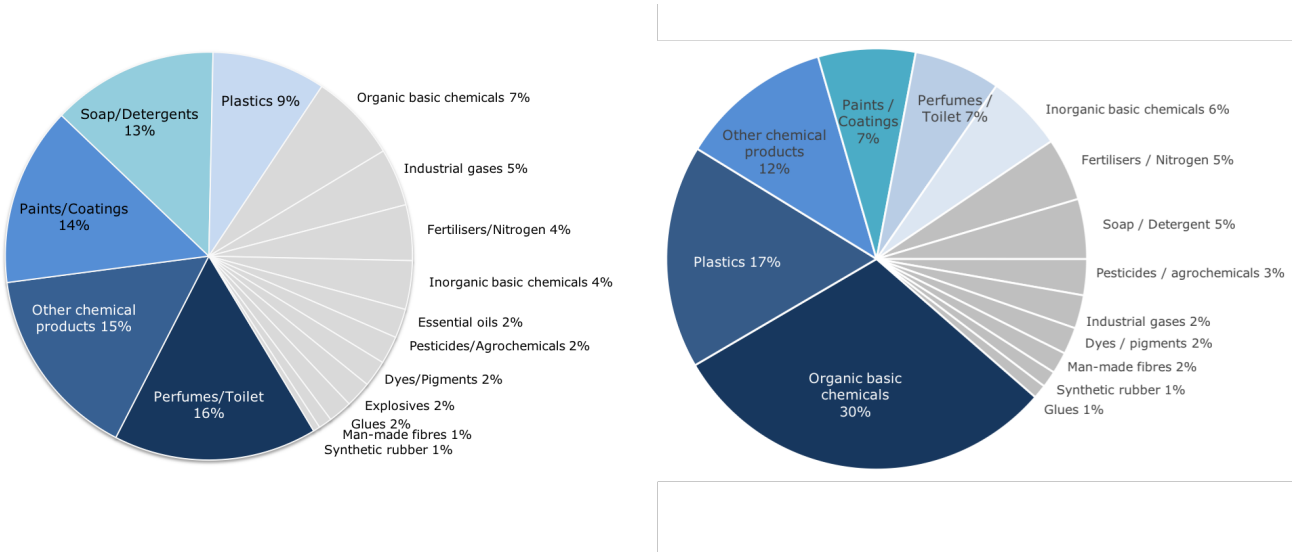


Source: Eurostat, last available data, 2012

As for **sectoral concentration**, over 65% of EU chemical companies are operating within five main subsectors, namely: perfumes and toilet preparations; paints, varnishes and similar coatings, printing ink and mastics; soaps and detergents, cleaning and polishing preparations; plastics in primary forms; other organic basic chemicals. A similar pattern of concentration in turnover is visible by subsector, with 73% (in 2012) of EU chemicals turnover generated by six subsectors: organic basic chemicals; plastics in primary forms; paints and coatings; perfumes and toilet preparations; inorganic basic chemicals.

Since 2009, the overall number of companies has declined in most subsectors, with particularly sharp decreases in: organic basic chemicals; paints, varnishes and similar coatings, printing ink and mastics; soaps and detergents, cleaning and polishing preparations; perfumes and toilet preparations; plastics in primary forms. Geographically, the UK, Poland, Romania, Portugal and Greece suffered from the largest reduction in companies, followed by Spain and Italy. On the other hand, the number of operating chemical companies increased in Belgium and Germany (Eurostat, 2015b).

Figure 3: Share of EU chemical companies (left) and their turnover (right) by subsector —2012

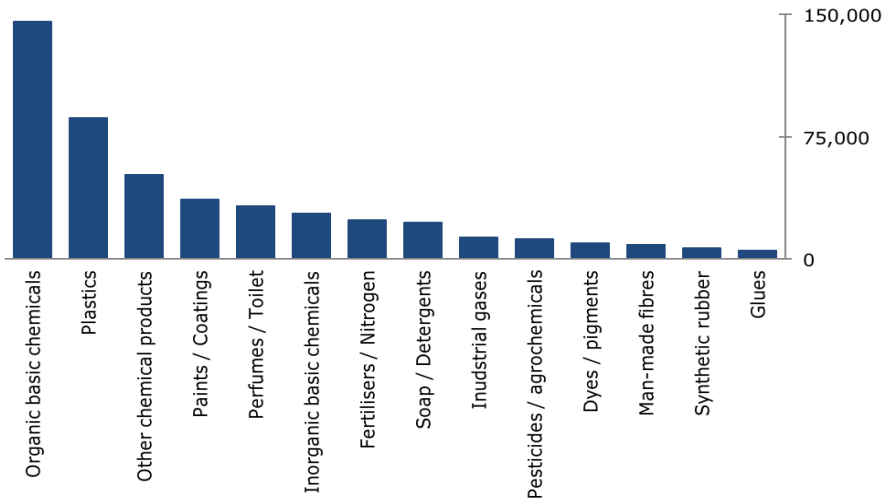


Source: Eurostat, last available data, 2012

The proportion of SMEs among all companies is stable among all subsectors of the EU chemical industry; SMEs represent between 96% and 98% of the number of companies.

Total production value for the chemical industry amounts to €500 billion. The subsectors with the largest contribution to EU chemicals production are organic basic chemicals and plastics in primary forms, respectively €145.6 billion and €86.3 billion. On the other hand, subsectors like synthetic rubber and man-made fibres, which account for a low total production value at EU level, have a higher production per company than most other subsectors. The majority of subsectors increased their production value per company from 2004–12.

Figure 4: EU chemical industry: Production value by subsector (€ million)

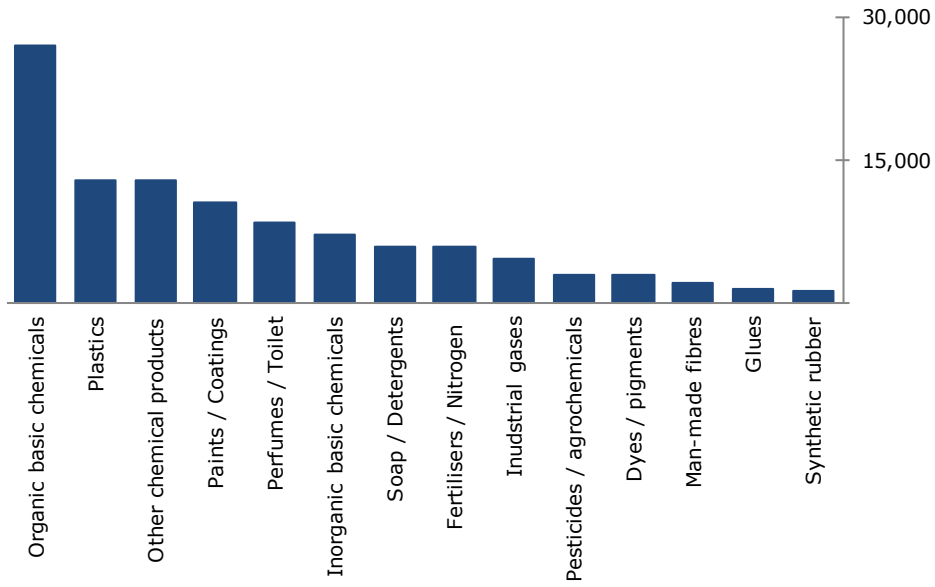


Source: Eurostat, last available data, 2012

The contribution of the subsectors to the total **value added** of the EU chemical industry varies markedly, with organic basic chemicals and specialty chemicals accounting for a significant share of value added. Other sectors with higher absolute value added are plastics in primary forms, inorganic basic chemicals, perfumes, toilet preparations, soaps and detergents. In contrast, the ranking changes significantly when considering average value added by company, with subsectors like synthetic rubber, man-made fibres and dyes and pigments recording higher value added per company.

While the global recession led value added to drop in 2009 in almost all subsectors, there has been a recovery, with 2010 and 2011 figures outperforming 2008 in some cases (Eurostat, 2015b). In a longer-run perspective (2004-12), value added increased in half of the subsectors and, notably, by 70% for 'other chemical products' (Eurostat 2015b).

Figure 5: EU chemical industry: Value added by subsector (€ million)



Source: Eurostat (2015b) last available data, 2012

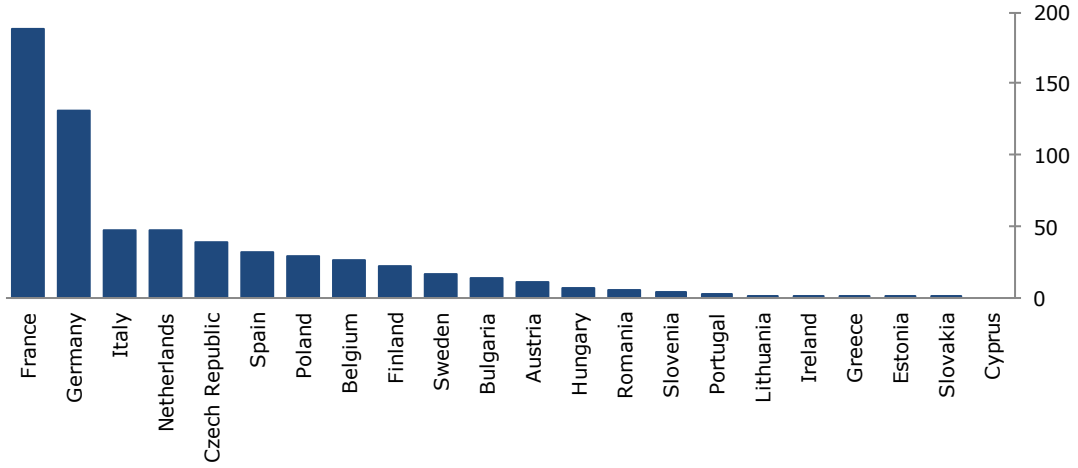
Capital investment is a key factor in securing the future development of the chemical industry and, in many cases, major equipment or plant renewals require long-term planning. Such investments are not only related to the improvement of productivity or introduction of new products but are also due to the need to comply with regulation or reduce operating costs. In particular, in order to improve energy efficiency and meet new environmental protection standards, there is an on-going need for new equipment, products and solutions that enable a more sustainable

use of resources along with more sustainable processes throughout the whole value chain (European Commission, 2009a).

The chemical industry subsectors with the highest gross investments in tangible goods[8], in absolute and relative terms, are organic and inorganic basic chemicals, plastics in primary forms, fertilisers and nitrogen compounds. The synthetic rubber subsector, at the bottom of the scale in absolute figures, has relatively substantial gross investments in tangible goods. Only 5 out of 16 subsectors have increased investments between 2004-12 (Eurostat, 2015b).

The extent to which chemical companies invest for environmental activities, mainly for pollution control and to resort to cleaner technology, highly varies among EU countries, from no investment reported in some countries to peaks of around €190 million for pollution control in France, and €360 million for cleaner technologies in Germany, reflecting substantial discrepancies in environmental agenda and priorities.

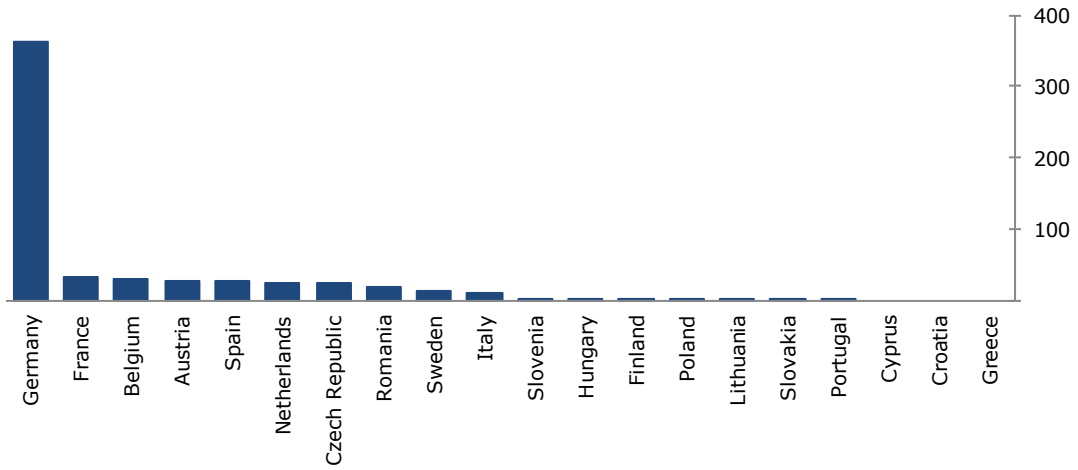
Figure 6: Investments in equipment and plant for pollution control — all subsectors of EU chemical industry (€ million)



Source: Eurostat, last available data, 2013

[8] Including new and existing tangible capital goods, whether bought from third parties or produced for own use (Eurostat, 2001). Tangible investments are investments in physical products, e.g. real estate and land, commodities, equipment, leasing, etc.

Figure 7: Investments in equipment and plant linked to cleaner technology — all subsectors of EU chemical industry (€ million)



Source: Eurostat, last available data, 2013

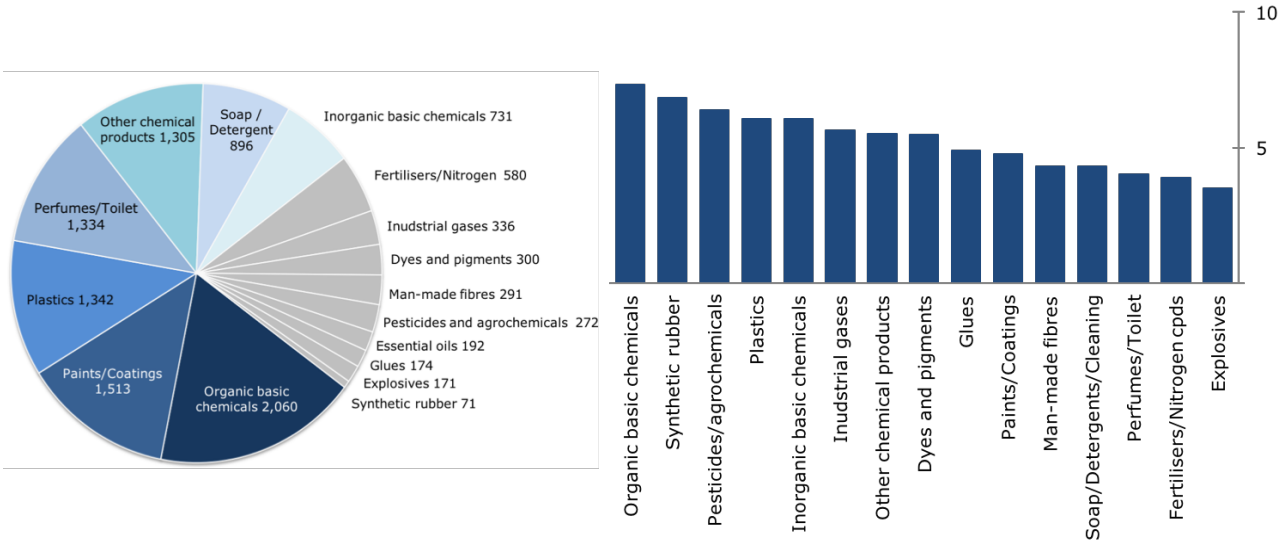
Employment is particularly high in five subsectors — manufacturing of organic basic chemicals; paints, varnishes and similar coatings, printing ink and mastics; plastics in primary forms; perfumes and toilet preparations; soaps and detergents, cleaning and polishing preparations — which are all sectors with a significant presence in the EU. Overall, in 2012 (last year available on Eurostat), the EU chemical industry employed 1.2 million people (Eurostat, 2015).

Subsectors with the highest personnel costs at the EU-aggregate level, are organic basic chemicals, plastics and paints. However, Figure 8 indicates that some subsectors with very low absolute value at EU-aggregate level appear to have the highest cost per employee, such as synthetic rubber or pesticides/nitrogen.

From 2004-12, personnel costs per employee have increased in all subsectors but at a varying pace: some subsectors, such as dyes and pigments and perfumes and toilet preparations remained relatively stable (with increases of 2% and 5%), while a subsector such as inorganic basic chemicals saw personnel costs jump by up to 30% (Eurostat, 2015).

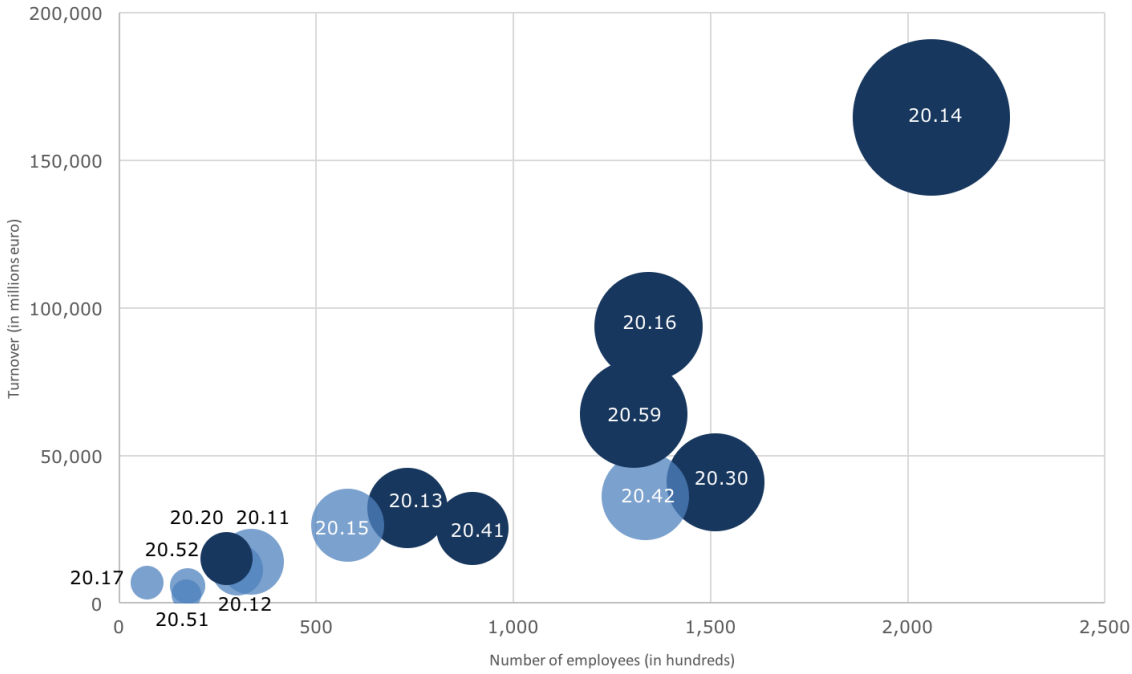
The final Figure 9 summarises the position of the subsectors with respect to turnover, number of employees and value added (the latter expressed through the size of the bubble). As expected, these three variables correlate positively and the biggest subsectors according to these criteria are organic basic chemicals, plastics in primary forms, other chemical products, paints and coatings and perfumes. This report provides a cumulative cost assessment of EU legislation for those subsectors coloured with dark blue in the Figure 9 below.

Figure 8: EU chemical industry: Number of employees by subsector in hundreds (left) and personnel costs in an average company by subsector in € million (right) — 2012



Source: Eurostat (2015b), last available data, 2012

Figure 9: Overview of EU chemical industry subsectors with respect to turnover, number of employees and value added (size of bubble)



Source: Eurostat (2015b), last available data for each subsector (including 2012, 2011 and 2010)

2.2 Product groups, production chains and cost structure within the chemical industry

The cost of legislation affecting the chemical industry varies from subsector to subsector and depends on the structure and the complexity of chemical manufacturing (e.g. the number of manufacturing steps, type of chemical process and equipment and hazard of chemicals). Some subsectors are affected by many pieces of legislation and some legislation requires measures that are more expensive than others. This section illustrates how the complexity of chemical manufacturing can influence the cost of legislation through examples of production chains.

2.2.1 Product groups and production chains in the chemical industry

Product groups, sometimes called product families or product lines, include elements relating to similar processes or presenting similar physical characteristics, while production chains reflect the steps that raw materials undergo to become finished products. In this sense, one subsector will include various product groups, which differ depending on the production chain they undergo.

Such product groups and production chains offer a good way to characterise chemical subsectors. In fact, many corporate activities, e.g. trade and sales, production, marketing, are often structured around production chains, and together these activities form business lines, which are largely reflected by subsectors at the four-digit level of the NACE classification system.

The European Inventory of Existing Chemical Substances (EINECS) includes over 100,000 substances. For obvious reasons it is not possible to assess the cost of legislation for each substance. However, assessing the cost of legislation of product groups that are particularly relevant for the subsector is a valid alternative. These product groups form the core businesses of companies and a meaningful base for international comparison.

The following examples illustrate typical product groups within four subsectors, implying different production chains for each of them. The methodology adopted in this study focuses on the cumulative cost assessment of different product groups, along their production chain.

Figure 10 Examples of product groups relevant in four subsectors

Organic Basic	Inorganic Basic	Paints & Coatings	Detergents
Olefins	Chlorine	Solvent based paints	Surface Care
Aromatics	Sulphuric acid	Printing inks	Laundry detergents
Solvents	Peroxides	Water borne paints	Dish Washing
Alcohols	Fertilisers	UV curing powders	Air Fresheners

Source: Authors' elaboration

2.2.2 Complexity of manufacturing and diversity of production chains

There is no unique definition of what raw material or finished products can be in one production chain. A production chain typically includes several steps of transformation of raw materials into intermediate chemicals that are then combined to manufacture semi-finished or finished products. A production chain can include numerous combinations of reagents, several transition phases (solid to liquid, liquid to gas, gas to liquid, etc.) and many separation and purification phases.

The main factors driving structural differences between production chains are:

- raw materials (crude oil, mineral, organic, waste, simple/complex molecules);
- the number of steps in the chain (transformation or simple formulation);
- the number of components or building blocks entering the production chain;
- the complexity of the end-products;
- the amount of emissions, by-products, and waste or residue;
- the final application of the product (industrial or consumer use).

The production of chemicals-based goods includes chemical reactions and physical changes, which present different degrees of hazard that may require specific risk management measures. Risk management measures can be voluntary or in compliance with specific legislation. This also leads to structural differences between production chains, having different cost implications.

Figure 11 Illustrative examples of complex production chains

Production steps	Organic Basic Ethylene	Inorganic Basic Chlorine	Inorganic Basic Ammonia
Raw material	Crude oil, petroleum gas	Sea water, Brine (sodium chloride)	Natural gas, LPG, air
Process steps I	Naphtha and refined gas production	Separation of ions by electrolysis	Desulphurisation, steam reforming, air separation
Intermediate chemicals	Naphtha, gas oils, gas feeds	Chlorine, caustic soda, hydrogen	Hydrogen, nitrogen
Process steps II	Cracking, separations,	Separation, purification, chemical reactions	Catalytic reaction
Semi-finished Products	Ethylene	Vinyl chloride	Anhydrous liquid ammonia
End products	Polyethylene	PVC	Nitric acid, ammonium nitrate, urea

Source: Authors' elaboration

The complexity of production chains is also affected by the number of stakeholders involved: manufacturing steps in a production chain can be divided and processed by individual operators or legal entities specialised in given tasks (e.g. purification, packaging, maintenance).

The link between the characteristics of production chains and the generation of cost by legislation is discussed in chapter 4.

2.2.3 Drivers of cost of chemical manufacturing

Factors affecting cost of production from product to product include the following:

- The cost of raw materials
- The cost of energy required
- The cost of reactants, catalysts and process equipment
- The effectiveness of the process (percentage yield, by-products, purification steps)
- The cost and the amount of labour needed
- The cost of risk reduction measures required during production, storage, transport and handling.

The following figures provide indicative ratios of production cost for three of the most important production chains in terms of production volume, number of applications and turnover, namely ethylene, chlorine and ammonia. These production chains were selected for their essential role as building blocks in the manufacturing of numerous intermediates used in the composition of thousands of products.

For instance, the major costs arising during the production of **ethylene** come from the following:

- Raw materials (market price of crude oil, natural gas, naphtha)
- Energy requirements (Energy intensive sector)
- Capital investments (CAPEX intensive sector)
- Equipment operating costs and maintenance
- Labour costs
- Health, safety and environment.

Figure 12 Organic Basic Chemicals – Indicative cash cost structure: Ethylene[9]

Cost categories	Cost (%)
Net Feed cost (Ethylene only)	**66.7**
Processing costs	**33.3**
Labour	*2.2*
Energy (heat, steam, electricity)	*22.2*
Maintenance	*5.6*
Other Variable	*0.6*
Other Fixed	*2.8*
Typical total cash cost	**100.0**

Source: Authors' elaboration based on company and industry reports

Figure 13 Inorganic Basic Chemicals – Indicative cash cost structure: Chlorine

Cost categories	Cost (%)
Raw materials	**20.0**
Processing costs	**80.0**
Labour	*4.0*
Energy (electricity and steam)	*36.0*
Operation and maintenance	*28.0*
Other Variable	*5.0*
Other Fixed	*7.0*
Typical total cash cost	**100.0**

Source: Authors' elaboration based on company data, Unep Global Mercury Partnership (June 2012), Prochemics (2008) and CEPS study on the composition and drivers of energy prices and costs in energy-intensive industries: the case of the chemical industry: Chlorine (2014)

[9] The figures illustrate the typical cash cost ratios for the production of ethylene using naphtha as feedstock. The net feed cost is based on the fraction of naphtha that is attributable to amount of ethylene (30%) produced out of a tonne of naphtha. The balance of the costs of naphtha is attributed to co-products (mixed C4, fuel, pygas, propylene…) and excluded from the above table.

Figure 14 Inorganic Basic Chemicals – Indicative cash cost structure: Ammonia

Cost categories	Cost (%)
Raw materials (Nitrogen and Methane)	**82.5**
Processing costs	**17.5**
Labour	*3.8*
Energy (electricity)	*5.0*
Maintenance	*5.0*
Other Variable	*2.5*
Other Fixed	*1.3*
Typical total cash cost	**100.0**

Source: Authors' elaboration based on company data, *Yara Fertilizers Handbook* (2012), and CEPS study on the composition and drivers of energy prices and costs in energy-intensive industries: the case of the chemical industry: Ammonia (2014)

Figures 12,13,14 highlight the relative proportion of energy and feedstock in the cost of production of ethylene, chlorine and ammonia. In the case of ethylene and ammonia, the largest part of the energy needed is contained in the raw material (naphtha and natural gas). This major part of costs is particularly sensitive to global energy prices affected by the global supply and demand for feedstock and fuels. The additional energy needed for processing (cooling, compression, liquefaction, storage…) is more sensitive to European and national measures affecting the prices of electricity. For the above reasons the production of ethylene, ammonia and chlorine, which are qualified as energy intensive,[10] can be affected either by international market price drivers and/or by regional and national measures.

[10] According to the "Energy Products Tax" directive (Directive 2003/96 EC, OJ L283 of 31.10.2003), "… an "energy-intensive business" shall mean a business entity ... where either the purchases of energy products and electricity amount to at least 3.0% of the production value or the national energy tax payable amounts to at least 0.5% of the added value."

3 Methodology

3.1 A cumulative approach of cost assessment

The aim of this study is to analyse the cumulative cost of the most relevant EU legislation that influences the EU chemical industry. While impact assessments traditionally focus on one specific action undertaken by the European Commission (new legal act, white paper, etc.), this study adopts a **cumulative approach**, by providing a quantitative assessment of all costs (monetary obligations, capital expenditure, operating expenses and administrative burden) incurred by chemical companies in Europe in relation to all EU legislation relevant to them.

This study **does not assess the benefits of EU legislation** and does not aim to provide insights related to the proportionality of costs and benefits of legislation, nor its efficiency or effectiveness. Furthermore, a **cumulative approach is to be distinguished from a non-cumulative approach** as traditionally used in a cost-benefit analysis (CBA). The standard cost-benefit approach examines the incremental costs and benefits related to policy proposals against a baseline. This implies that a CBA focuses on the net change in costs and benefits, relevant to a specific policy decision, not the aggregate (or cumulative) level of regulatory costs and benefits (European Commission, 2015). On the other hand, the cumulative cost assessment (CCA) focuses on the whole sector, rather than on a particular policy proposal or legislation, and aggregates the costs generated by all relevant existing EU legislation. Hence, this cumulative cost assessment does not focus on a policy field and does not aim at assessing whether the regulatory framework is fit for purpose in a policy field, which is an approach used when conducting fitness checks.

While there is no recognised standard methodology for the assessment of cumulative impacts, the methodology of this study draws on previous similar cumulative cost assessment exercises performed by Member States and the European Commission. For the overall CCA approach the previous studies on the aluminium and steel industries (CEPS, 2013a and CEPS, 2013b) have been consulted. In particular, for the estimation of the various types of costs, CCA studies are based on established methodologies that have been used for several years by Member States and the European Commission, including the Standard Cost Model, or the Cost-driven Approach to Regulatory burden (CAR) developed for the Dutch Government.

The Standard Cost Model methodology (SCM) is used by several Member States (Network Standard Cost Model, 2005), as well as the European Commission, as part of its REFIT programme[11] and the "Better Regulation

[11] http://ec.europa.eu/smart-regulation/refit/admin_burden/scm_en.htm

Toolbox" (European Commission, 2015). The CAR methodology, used by the Dutch government (SIRA, 2015), is similar to the SCM, yet its scope is broader regarding the types of cost covered and gives more emphasis to linking legislation cost with the cost structure of companies.

Methodologies to measure legislation burden follow the principle, summarised by the European Commission in its presentation of the SCM: "the purpose of the SCM methodology is to produce estimates that allow **an order of magnitude** of the burdens in different regulatory areas to be identified. Considering the level of detail and the number of parameters, **it is not cost-efficient to seek statistically valid results rather than more general estimates**" (European Commission, n.d.).[12]

Applying statistical methods would require large samples, with a significant number of strata, due to the complexity of the system. Such approaches are disproportionally expensive and time-consuming, and they are not feasible within the time frame and budget of a cost assessment exercise. Thus, instead of statistically valid samples, the concept of **ideal type** of companies, **typical companies,** or **model companies** is used — for example, the Better Regulation Toolbox (European Commission, 2015, p.369) or the methodology used by the Dutch government (SIRA, 2015, p.40). A typical company **is not an average firm in statistical terms** but an entity that is neither particularly efficient nor inefficient in terms of complying with the legislation. Examples on how this definition could be applied in practice are presented in the Better Regulation Toolbox (European Commission, 2015 p. 370).

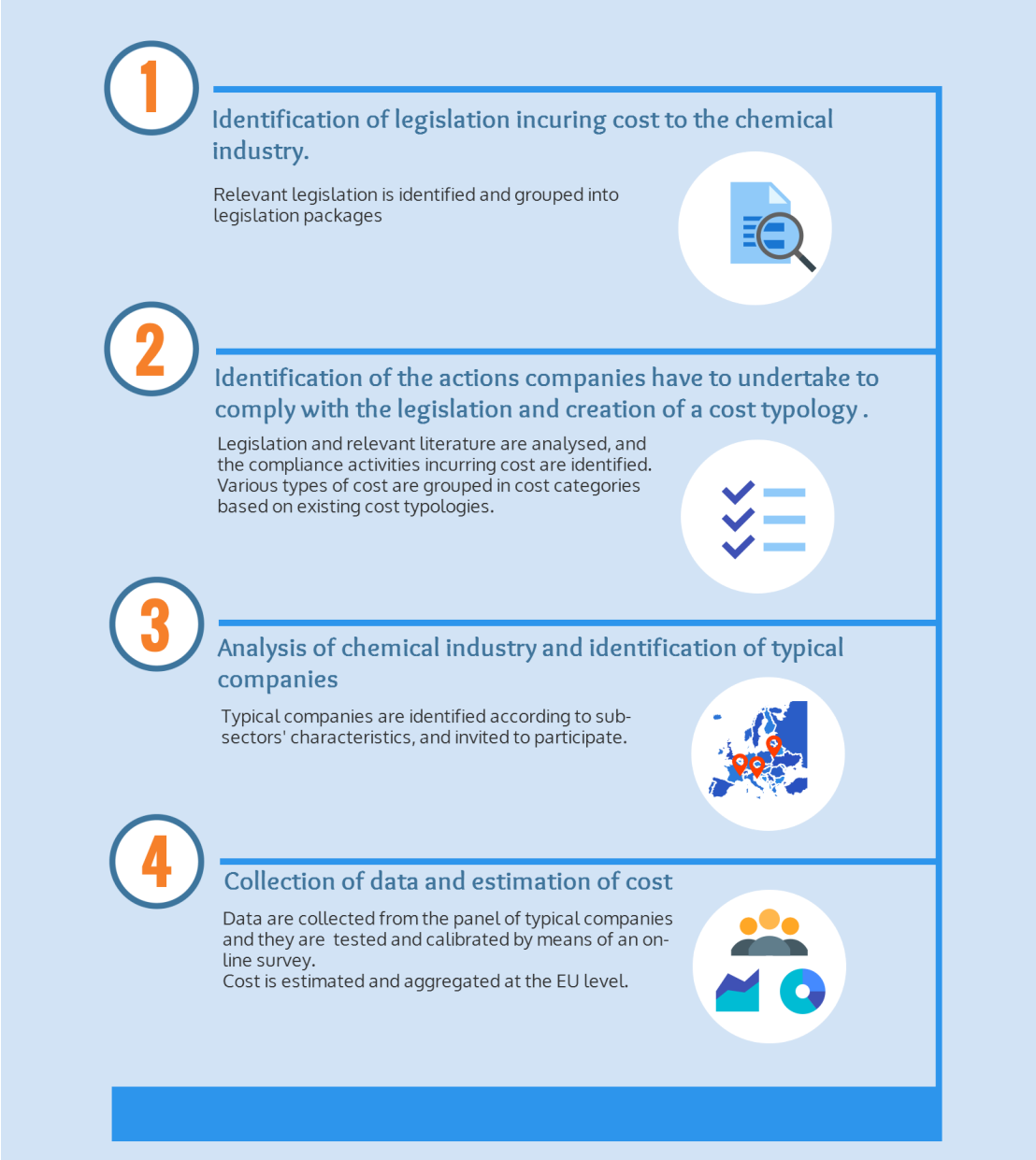
Following a variation of the above approach, data collection in the current study **did not rely on statistical methods**. Detailed data were collected from a panel of **typical companies** identified using a set of tangible criteria (see section 3.4)**,** which then were validated in two workshops and calibrated using a larger sample of companies by means of an online survey. Finally, the data were aggregated to the whole population. The method is explained in more details in the following sections.

Despite the significant advantage regarding feasibility, the method is less accurate compared to statistical methods, and it can only provide an **estimate of the order of magnitude of cost** borne by companies due to EU legislation.

The methodology is implemented through four steps illustrated in Figure 15 and described in the following sections.

[12] Emphasis in bold was added by authors'.

Figure 15: Steps for implementing the cumulated cost assessment



Source: Authors' elaboration

3.2 Step 1: Identification of legislation incurring cost to the EU chemical industry

The project team articulated an initial list of legislation, including around 200 pieces of legislation affecting the chemical industry to various extents. To verify the list and identify the most relevant pieces of legislation, 23 sectoral associations and institutes were contacted and requested to assess the pieces of legislation, based on a 'Likert scale'.

Despite persistent follow up of all subsectors under the scope of the CCA study, 12 Industry Trade Associations (Table 1) out of 23 replied to the invitation to prioritise legislation with the largest cost impact.

In order to provide a complete priority assessment of all legislation for all subsectors, we compared the industry profiles of the subsectors, which participated in the priority assessment with those, which did not respond. Using analogy criteria, we developed a complete pattern of priority legislation.

Table 1: Industry associations contributing to the prioritisation of legislation

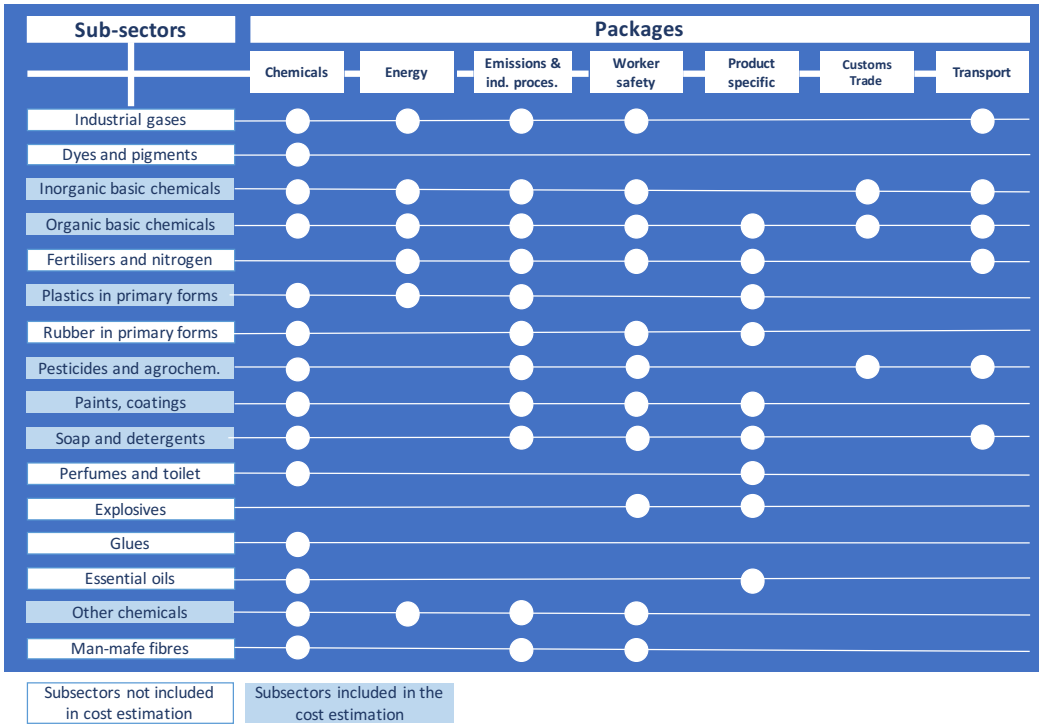
Industry association	Subsector
Petrochemicals Europe	20.14 Organic basic chemicals
Plastics Europe	20.16 Plastics in primary forms
International Institute of Synthetic Rubber Producers	20.17 Synthetic rubber in primary forms
European Tyre and Rubber Manufacturers' Association (ETRMA)	20.17 Synthetic rubber in primary forms
European Man-Made Fibres Association (CIRFS)	20.60 Man-made fibres
European Industrial Gases Association (EIGA)	20.11 Industrial gases
EuroChlor	20.13 Inorganic basic chemicals
European Crop Protection Association (ECPA)	20.20 Pesticides and agrochemicals
Association of paints, coatings, inks (CEPE)	20.30 Paints, coatings, mastics and inks
International Association for Soaps, Detergents and Maintenance (AISE)	20.41 Soaps and detergents, cleaning and polishing preparations
International Fragrance Association (IFRA)	20.53 Essential oils
Silicones Europe	20.59 Other chemical products

Source: Authors' elaboration

The results were discussed further with industry and stakeholders, and a final list of around 70 pieces of legislation was produced.

To facilitate the collection of data and the estimation of cost, the pieces of legislation have been grouped into seven packages based on their overarching and specific policy objectives. In some packages, pieces of legislation were further grouped into sub-categories based on the similarity of their cost generation mechanism. Framework legislation (e.g. the Waste or Air Quality Framework Directive) and their "daughter" legislation are presented together, as the former sets the general principles while the latter sets the implementation measures and therefore costs. The results of this grouping, indicating the relevance of packages to specific subsectors, are shown in Figure 16.

Figure 16: Legislation packages per subsector



Source: Authors' elaboration

3.3 Step 2: Identification of the actions required for compliance and creation of a cost typology

The selected pieces of legislation, grouped into seven packages, were analysed and the actions that companies have to take to comply were identified. The actions were then associated with cost categories identified in the European Commission's Better Regulation Toolbox (European Commission, 2015a) and previous cumulative cost assessment studies for steel and aluminium industries (CEPS, 2013a and CEPS, 2013b). Chapter 4 presents the results of the analysis per legislation package.

The studies have identified two main categories of cost[13]: direct cost and indirect cost.

[13] A third category named "enforcement cost" is also included in the cost classification; however, it mainly concerns the public administration and the authorities responsible for the enforcement of the legislation.

Direct cost is directly incurred due to the legislation. Two types of cost can be identified under this category:

- Costs defined in details in the legislation or other administrative acts, of which exact amount can be reliably estimated (e.g. REACH registration fees, taxes or levies).
- Costs directly borne by companies in order to comply with the requirements and standards set by the legislation, although the exact cost is defined by investment decisions of the companies, the specific business environment and price structures, the technologies available or other factors not directly related to or affected by the legislation. An example of such types of cost is investment in technologies to reduce emissions, to comply with the limits set by legislation. Although the legislation defines the limits — and often requires the use of the best available technology — the final selection of the specific technology and equipment, and hence of the cost, is the firms' decision. The estimation of such cost is straightforward although the accuracy of the estimate depends on information provided by the companies.

Indirect costs are also generated as a result of legislation requirements. However, either they are incurred by other companies upstream in the value chain and passed on to chemical companies through the price of inputs, or they are related to opportunity costs due to the substitution of products and the loss of markets. Although some of the pass-on cost could be estimated (e.g. the effect on electricity prices), several of its components (e.g. opportunity cost) are difficult to be quantified and their estimation can only be based on assumptions.

Due to the ambiguities of the indirect cost and the limited, mainly qualitative, information provided by companies about the pass-on and opportunity cost, no robust assumptions could be made for the estimation of the indirect cost and, therefore, it has been excluded from the assessment.

Thus, **the typology of cost used in this study includes the following types of direct cost** which are illustrated in Figure 17:

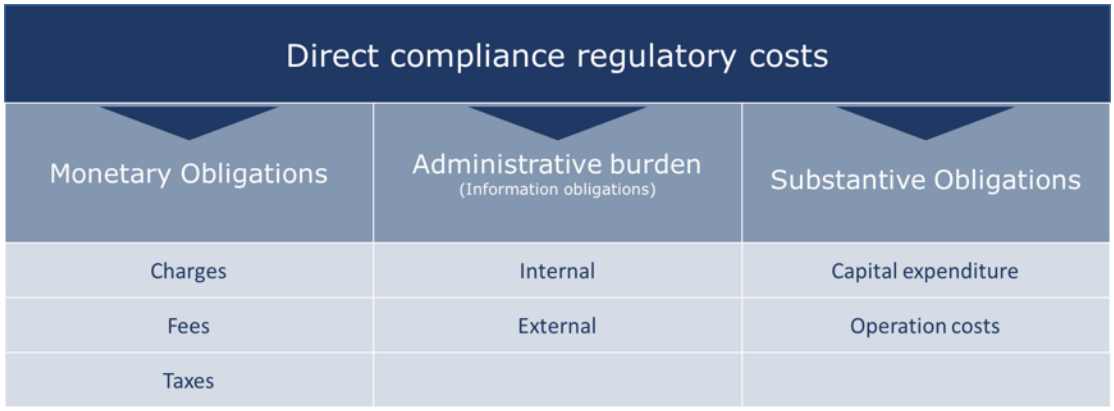
- **Monetary obligations** are regulatory charges such as fees, levies, or taxes on certain stakeholders. The identification and computation of such costs are rather straightforward as regulatory charges' amounts are usually known and their extent is clearly communicated to a company. Typically, they include registration fees paid to the European Chemicals Agency (ECHA) for the registration of chemicals under the REACH Regulation or registration fees paid to Member States for the examination of biocidal active substances. Other examples include national environmental taxes and charges, and net costs for CO_2 emission allowances for companies covered by the EU's Emissions Trading Scheme (ETS).
- **Administrative burden** is defined as the cost of fulfilling the **information obligations** to public authorities or other third parties as required by legislation. It is important to note that administrative burden is different from administrative cost, as administrative burdens only represent part of administrative cost and do not integrate

business-as-usual costs that would nonetheless occur in the absence of legislation. Administrative burden can be incurred internally (e.g. staff time) or externally by receiving help and advice such as verification, which may or may not be mandatory. The types of administrative burden identified in previous studies on cumulative costs include cost of personnel, laboratory testing (internal or subcontracted), consultants, and necessary training.

A methodological challenge in the assessment of administrative burden relates to the difficulty of identifying the origin of the burden — whether burdens can be solely attributed to the minimum requirements of EU legislation or whether they go beyond minimum requirements ("gold-plating") at national level. This was taken into account by asking companies surveyed to report the portion of administrative burden attributable solely to implementation of the European legislation. However, there is no obvious way to ensure that there is no overlap in administrative burden estimates.

- **Substantive Compliance Costs** are provisions made to comply with regulation, which can be further broken down according to the following categories: capital costs (CAPEX) and operating costs (OPEX).

Figure 17: Cost categorisation



Source: Authors' elaboration

Capital costs include any acquisition or upgrading of physical assets, (buildings or equipment), usually "fixed costs", but also investment costs from investments necessary to meet legal obligations. Investment costs can be one-off costs (new equipment needed and related training) or recurrent costs (periodical training or tests). Operating costs include maintenance cost and additional expenses for personnel (wages), energy inputs, materials, consumables associated with legal acts, and are usually "variable costs".

3.4 Step 3: Analysis of chemical industry and identification of typical companies

3.4.1 Criteria for selecting typical companies

The definition of "typical" or "model" company is related to the efficiency of a company in complying with legislation, so it can only be applied ex-post. In addition, since several pieces of legislation are examined and a wide range of compliance activities considered, the compliance efficiency is affected by several processes and functions of the companies. Therefore, in the selection of firms, more operating ex-ante criteria are required, linking firms' compliance efficiency with those of their characteristics that could be observed at the selection stage.

In this regard, the CAR methodology (SIRA, 2015) suggests three criteria for regarding a company as "typical" or "model", which were used in the current study:

1. The activities (production chains), processes and products of the company are similar or comparable to other firms operating in the same subsector. As argued in section 4.1, the cost of legislation for chemical companies is affected by the structure and the characteristics of the production chain, such as the number of manufacturing steps, the type of chemical processes and equipment, the requirements in energy, the type and hazardousness of products, etc. Therefore, a typical company in terms of its activities is expected also to be typically efficient regarding its compliance with legislation.
2. The company is typical (no significant variation) in terms of its business, its structure and its business operations. Differences in size (SMEs, large companies) were also considered.
3. The business operations of the company are clear, and the cost generation can be associated with specific business activities and production sites. This criterion applies to large corporations with several sites and activities.

In addition to the above, the **overall efficiency** of a company is also relevant since, on the one hand, the legislation cost is part of the operating and production cost of a company and, on the other hand, the efficiency in specific tasks is also affected by the overall efficiency of the company. A good proxy for the cost efficiency that can be estimated by using the available data is productivity, measured as turnover per person employed.[14] Thus, by comparing the productivity of all selected companies with the productivity of their sector it was checked whether the selected panel of companies consists of outliers or companies close to the average,

[14] Although gross value added per person employed could be a better proxy, value added is not available for individual companies.

and therefore whether there is a risk of over- or under-estimating the cost.

3.4.2 Analysis of industry and selection of companies

In order to identify companies fitting the above criteria, the structure of the subsectors was analysed in terms of fundamental metrics (e.g. number of companies, size, turnover, employment, country distribution), product groups, production chains and cost structures.

Invitations for participating in the study were sent to **pre-selected** companies on the base of the above criteria. The European Chemical Industry Council (CEFIC) and industry associations supported the identification of companies and the dissemination of the invitations. However, two significant constraints tended to reduce responses from companies:

- The collection of all necessary information is a time-consuming and costly process, as within the accounting systems of companies the cost of legislation is usually not tracked as a specific item.
- Several companies, large ones in particular, raised concerns about the confidentiality of any information they provided.

As a result, not all companies were willing to undertake the burden of data collection, especially among SMEs, or to take the risk of disclosing vital information. Finally, a panel of 31 companies grouped into six subsectors was formed.[15] The characteristics of the panel are presented in Figure 18.

Although only a fraction of the pre-selected companies participated, the final panel of companies is comprised of typical companies, which adequately cover their subsector, given their product range, technology used and size.

The **inorganic basic chemicals** (C20.13) subsector includes production of chemical elements, inorganic acid such as sulphuric acid, bases such as caustic soda, alkalis and other inorganic compounds such as chlorine. All processes are capital and energy intensive. EU-based companies are mostly large multinational groups operating multiple production sites and trading chemicals in a global market. They operate under high standards of compliance on health, safety and environment (HSE). **Chlor-alkali producers** are good proxies for this subsector and represent adequately the average operations for chemical production, HSE standards, industrial processes and capital-intensive equipment.

[15] Seven NACE Rev.2 subsectors were covered of which 20.20 and 20.59 were merged into specialty chemicals resulting finally in six subsectors.

Figure 18: The panel of typical companies

Subsector	Number of companies	Products covered	Countries covered	Size
20.13 Inorganic basic chemicals	4	Chlor-alkali (chlorine and hydroxides)	SP, NL, DE	Large, SMEs
20.14 Organic basic chemicals	13	Ethylene crackers (olefins, aromatics, solvents)	NL, SP, SE, IT, NL, DE, BE, FR	Large, SMEs
20.16 Plastics in primary forms	2	Polypropylene, Polyethylene, Polycarbonate, Polystyrene	SP, NL	Large
20.20 Pesticides	3	Organic agrochemicals, insecticides, herbicides, fungicides, biocides	BE, DE, IT	Large, SMEs
20.41 Soaps & Detergents	6	Professional/industrial cleaning, Household/consumer detergents	BE, UK, FR, NL	Large, SMEs
20.30 & 20.59 Specialty chemicals	3	Coating materials (paints, varnishes, etc.) Silicones	IT, BE	Large, SMEs

Source: Authors' elaboration

The **organic basic chemicals** (C20.14) subsector includes manufacturing of chemicals using basic processes, such as thermal cracking and distillation. All processes are capital and energy intensive. Companies operating in EU are mostly large multinational groups operating multiple production sites and trading chemicals in a global market. About 100 large companies manufacture base organic chemicals in the EU and present comparable operating structure. They operate under the same high standards of compliance on health, safety and environment (HSE). Companies operating **steam crackers** represent 64% of the production of the subsector and are good proxies for this subsector. They represent adequately the average operations of the subsector in terms of production, HSE standards, industrial processes and capital-intensive equipment.

Plastics in primary forms (C20.16) subsector includes the manufacture of resins, plastic materials and elastomers. Manufactures of polymers in primary forms is in most cases integrated to petrochemicals sites and business units apply the same standards of compliance with HSE legislation as their suppliers of building blocks. Polymer units are homogeneous with regards to HSE and regulatory requirements and represent 80% of the production in volume of the subsector.

Pesticides (C20.20) include the manufacture of pesticides and agrochemicals excluding fertilisers and nitrogen compounds. The subsector comprises a mix of SMEs and a small number of large enterprises. All companies operating in the subsector comply with the same legislation and incur similar compliance efforts. The subsector is homogeneous concerning HSE requirements and product compliance. Companies in the panel cover all product chains of the subsector. Therefore, differences in legislation costs could arise due to the scale of the business, the number of products placed on the market and the production volumes rather than the type of organisation or production

processes. Thus, SMEs and large companies were selected to ensure a correct estimation of the respective costs.

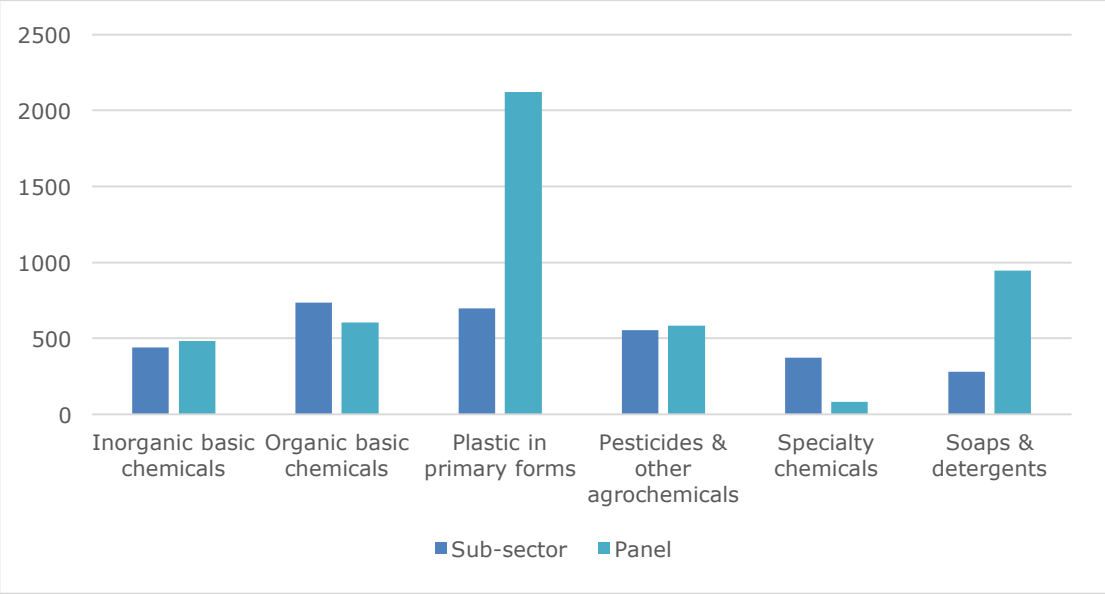
The **soaps and detergents, cleaning and polishing preparations** subsector (C20.41) comprises a very large number of end products and preparations. Products and operators can be divided into two homogeneous sub-groups, manufacturing **household and consumer detergents** on the one hand and **industrial cleaning and disinfectants** on the other hand. The structural organisation of the business, HSE concerns and the regulatory requirements differ for both groups and the proportionality of compliance efforts vary with the size of the company. Therefore, companies were selected in each sub-group with special attention to including both SMEs and large operators. The product chains of the selected companies represent 92% of subsector's production in volume.

The **specialty chemicals** group (C20.30 and C20.59) is by far the most heterogeneous group concerning products, applications, production processes, HSE requirements and business structure. With the exception of specific products legislation, most production processes and operations must comply with similar regulation and are therefore comparable in terms of HSE requirements. **Silicone** manufacturing and **paints and coatings** manufacturers are two good examples of specialties and preparations that can be transposed to other manufacturing processes and operations within the subsector. However, the significant heterogeneity of the group may reduce the reliability of estimates.

Comparing the companies in the panel with their corresponding subsectors it can be seen (Figure 19) that the productivity of the selected companies in the **inorganic basic chemicals**, **organic basic chemicals** and **pesticides** is very close to the average of their subsectors. In the case of **plastics** and **soaps and detergents** the productivity of the panel companies is more than three times higher than the subsectors' productivity. Higher productivity indicates lower cost per value added or turnover and therefore the legislation cost for the two subsectors could be **underestimated** by using the cost of panel companies. Finally, in the case of **specialty chemicals** the panel companies underperform compared to subsector's average indicating that the legislation cost could be **overestimated**.

To conclude, based on the comparison of productivity, the risk of **underestimating the legislation cost is rather higher than the risk of overestimating.**

Figure 19: Comparison between the panel of companies and chemical industry by subsector – average of turnover in thousand euros per person employed, 2012



Source: Data at subsector level from Eurostat, panel data collected by authors

3.5 Step 4: Collection of data and estimation of cost

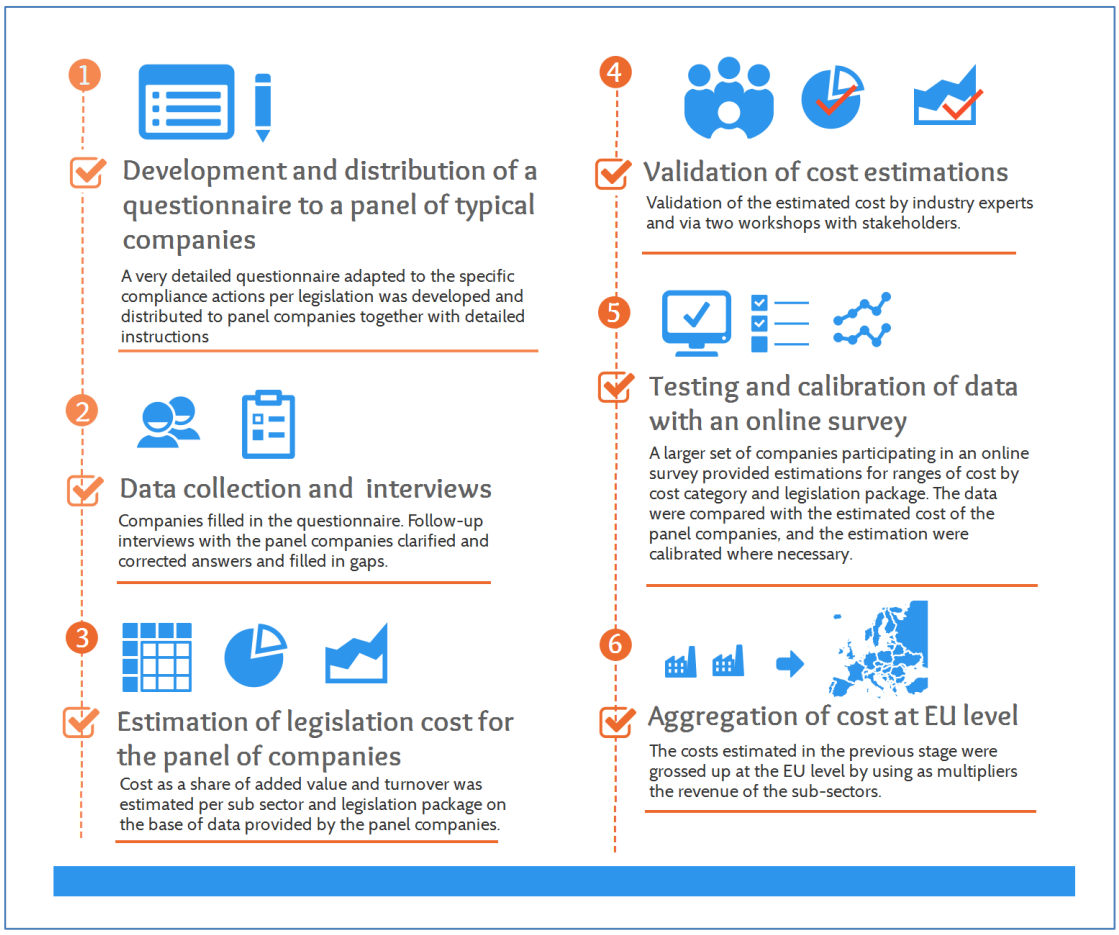
The legislation cost borne by the panel companies was estimated by following a six-stage approach illustrated in Figure 20.

1- Development and distribution of a questionnaire to a panel of typical companies

A detailed questionnaire was designed in collaboration with industry experts. It was distributed to the 31 companies of the panel considered typical to represent the situation in the different subsectors of the chemical industry and that have agreed to participate.

The questionnaire (Annex II) includes questions applying to all companies, and seven legislation-specific sections with questions relevant to actions undertaken by companies to comply with those specific pieces of legislation. The legislation-specific sections apply only to subsectors affected by specific legislation packages (see Figure 16).

Figure 20: Methodology for estimating legislation cost



Source: Authors' elaboration

2- Data collection and interviews

The questionnaires were collected and quality-checked. Where possible, the answers were compared with data obtained from the literature. In total 72 studies were scanned, and two agencies (ECHA and OSHA), along with the JRC-IPTS, were contacted for this purpose. Fees, cost rates, multipliers and other relevant quantitative data were used as an additional means of identifying inconsistencies and outliers, as well as to validate data collected via the questionnaires. In the case of identifying significant differences in the order of magnitude of the reported cost in the questionnaire and the data obtained from the literature, the data were checked again with the companies. Furthermore, responses to each question were also compared between companies to identify outliers. Inconsistencies were investigated by directly contacting the companies.

Interviews followed the collection and quality check of the questionnaires, with the aim of harmonising the answers to the questionnaire across interviewed companies, clarifying responses and completing missing data. Interviews ensured a common understanding and comparability between and among subsectors.

3- Estimation of legislation cost for the panel of companies

Cost figures from the detailed questionnaire were used to calculate the average cost as a percentage of turnover per size category and subsector for each cost category and legislation package. Secondary data from literature and agencies were also used at this point, to check whether the estimated costs fall within the reported cost ranges. In very few cases, where unexpected divergence was observed, the data were crosschecked with companies and experts and the initial assumptions were reviewed.

4- Validation of the estimations

Two validation workshops were organised to validate the estimated costs as a percentage of both the value added and the revenue of the reporting companies, before the grossing up of costs for the EU level and the estimation of absolute values.

The first validation workshop targeted companies and industrial associations. The second workshop, organised by the European Commission, was open to a wider audience of stakeholders such as industry, trade unions, NGOs and Commission services.

Both validation workshops concluded that the order of magnitude of the provided data is within the expected ranges. Clarifications were also requested and comments were provided for improving the estimates and the presentation of data.

5- Testing and calibration of data with an online survey

An online survey, targeting a larger population of companies across the six subsectors, was used to test and adjust the legislation costs estimated in the previous stages.

The questionnaire was adapted to the constraints of an online survey, and kept simple and relatively short. Companies were requested to select the most appropriate from a list of ranges of costs, expressed as a percentage of turnover, for each legislation package and each category of direct cost (monetary obligations, capital expenditures, operating expenses and administrative burden). In each question, one of the provided options was the cost estimated in the previous stages (without any indication of this, however).

The link of the questionnaire was distributed to companies by the national industrial associations of the subsectors participating in the study. Overall, 90 companies responded to the survey, so in total 121 companies (including the companies in the panel) provided cost inputs for the study. The coverage of subsectors, legislation packages and countries are presented in the following tables (Table 2 – Table 4).

The results of the survey supported the cost rates (cost per turnover) as initially estimated based on the panel of typical companies, since the medians of the online responses were within or very close to the estimated ranges in each case.

Table 2: Responses by subsector

Subsectors	Panel of typical companies	Online Survey	Total number of responses
Inorganic basic chemicals	4	15	19
Organic basic chemicals	13	11	24
Plastic in primary forms	2	7	9
Pesticides & other agrochemicals	3	10	13
Specialty chemicals	3	24	27
Soaps & detergents	6	23	29
Total	31	90	121

Source: Authors' elaboration

Table 3: Responses by legislation package

Legislation packages	Panel of typical companies	Online Survey	Total number of responses
Chemicals legislation	28	83	111
Energy legislation	11	32	43
Industrial emissions and processes legislation	25	58	83
Workers safety and health legislation	15	60	75
Chemicals specific product legislation	7	39	46
Customs and trade legislation	6	23	29
Transport legislation	1	45	46

Source: Authors' elaboration

Table 4: Responses by country

Country	Panel of typical companies	Online Survey	Total number of responses
Austria	1	1	2
Belgium	3	7	10
Czech Republic		1	1
France	3	13	16
Germany	4	13	17
Hungary		1	1
Italy	4	5	9
Netherlands	5	13	18
Poland		1	1
Portugal		4	4
Slovenia		3	3
Spain	5	17	22
Sweden	1	2	3
United Kingdom	5	9	14
Total	31	90	121

Source: Authors' elaboration

The results from the online survey were then used to adjust costs by size, subsector, legislation package and cost category by calculating a weighted average from the initial panel figures and the median cost figures from the survey (see Annex 3). Final figures were computed by using a weight of 75% for the initial figures and 25% for the figures from the survey.

A lower weight was used for the survey results in order to reflect the importance of the validation procedures that were conducted via interviews, workshops and secondary data to arrive at initial figures. It also reflects that ranges from the survey are less accurate than exact figures provided in the detailed questionnaires.

A sensitivity analysis over different sets of weights was implemented. Overall, the results of calibration are stable according to the different scenarios. Furthermore, the direction of the adjustment is not systematic (some initial figures were underestimated while others were overestimated). The lack of a systematic bias supports the assessment that the approach is robust. The results of the sensitivity analysis are also presented in Annex 1.

6- Aggregation of cost at the EU level

The total cost at the EU level was estimated by grossing up the adjusted costs of the panel companies (see Annex 1). For each size category and subsector, the average costs per unit of turnover of the corresponding panel companies were multiplied by the corresponding turnover, as published by Eurostat.

Finally, the grossed up costs were presented as a share of value added, turnover and gross operating surplus of each subsector.

3.6 Methodological assumptions, challenges and limitations

In this section we discuss the scope of the assessment regarding the types of costs, the advantages and limitations of the applied methodology, and the main assumptions and measures we took to effectively overcome the challenges identified.

It has to be accepted, however, that CCAs are not necessarily providing fully comprehensive statistical data in the strict sense. For some sectors or subsectors it is often impossible to collect sufficient data directly from companies in order to qualify for a statistically representative sample; especially if companies are very numerous and in a sector of more heterogeneous character.

Due to different circumstances (the time frame of the study, the required effort and confidentiality issues), 31 companies accepted replying to the interview, and 90 more to the online survey.

CEFIC, the European Chemical Industry Council association for chemicals, and other industry associations played an active role in mobilising companies, contacting them and requesting their participation in the study. CEFIC facilitated communication, exchange of information and other practical issues. Since the CCAs are based on a bottom-up approach, collaboration of plant operators and collection of primary data

have been necessary; in all analyses the strict confidentiality has been maintained.

Direct versus indirect cost:

The estimation of cost is restricted to costs incurred directly by chemical companies, excluding indirect costs, for the following reasons:

- Although companies reported cases of opportunity or transaction costs, they were not in a position to quantify them.
- Costs passed on to chemical companies through the prices of inputs (e.g. raw materials, or electricity) represent indirect costs for chemical companies but direct costs for the upstream sector. Therefore, in order to avoid any double counting, in case similar exercises are carried out for upstream sectors, these costs should be included in the cumulative cost assessment for those sectors only.
- Although pass-on costs could be significant, there is no reliable method to estimate most of these types of costs.

Business as usual (BAU): The CCA study focuses strictly on costs arising from the implementation of European legislation, so costs associated with 'business as usual' are excluded. BAU cost can be understood as the cost that a company would bear even in the absence of regulation, based solely on its commitment to responsible care or corporate social responsibility, or emerging from the need to adapt to changing production conditions, or for marketing reasons or the request of clients.

The present study adopts the methodological recommendations of the European Commission's Better Regulation Toolbox for the estimation of BAU (European Commission, 2015). According to these recommendations, the information regarding the BAU for each cost category should be directly provided by the interviewed companies, which are invited to clarify whether the expenditures associated with a piece of legislation would still have been made in the absence of the legislation.

European vs. national differences: National legislation that is not related to EU legislation is excluded from the study. EU Regulations enter into force immediately upon adoption and apply directly, whereas EU Directives enter into force at the national level by being transposed into national legislation. If they wish, Member States can adopt tighter requirements when implementing Directives, in order to respond to particular national concerns. Companies participating in the panel and the online survey were therefore asked to report only the costs associated with the requirements set out in the relevant EU legislation. Although it was not possible to verify, panel companies reported a limited number of areas where tighter requirements, hence additional costs, could arise.

In the case of energy taxes a distinction between the costs generated by the EU policy and those by the national legislation was not possible. Therefore, in this case, the estimated cost includes also the effect of the national legislation.

Double counting / attribution to legislation: Actions taken by companies are often related to more than one piece or package of

legislation. To avoid double counting of such costs, possible cases of double counting were identified in the questionnaire, and companies were asked to estimate the share of these costs corresponding to each specific legislation package taking into consideration the different pieces of legislation of each package. Although the costs are aggregated at the level of the legislation package, companies had a list of the pieces of legislation that were included in each package as a reference for their estimations.

Time span: The reported costs are annualised following established business practices.

Although the reported costs refer to legislation, in some cases costs were incurred shortly ahead of the date of adoption or before the date of transposition of some legislation. Because industry operators schedule significant investments over extended periods, firms anticipate regulatory requirements to avoid disruption of production outside scheduled turnarounds or to prevent shortages of resources when legislation is adopted.

This behaviour is particularly relevant for the retrofit or upgrade of process equipment that must comply with stricter emission limits. In such cases, companies upgrade their equipment during plant turnarounds or scheduled maintenance to ensure timely compliance with legislation that will be adopted in the near future.

In this study therefore, to avoid complex allocation of costs during the reference period, the starting point of costs incurred is defined as the date of adoption of the EU legislation, independent of the date of transposition into national legislation.

The information collected on regulatory costs is the most reliable for present times. For previous years, companies provided the information that shall be considered as an estimate of the trend based on a subset of companies and their recollections of past costs.

Advantages and limitations: As pointed out, the methodology used in this study is a practical alternative to more accurate, but more time- and resource-consuming statistical methods. It also offers the necessary granularity and focus that top-down approaches based on existing national and European statistics lack. An example of the latter is the Environmental Expenditures Statistics of Eurostat. Although it offers accuracy in the estimation of environmental CAPEX and OPEX, its scope regarding the type of expenditures is quite different, and it does not distinguish between legislation-driven and business-as-usual expenditures.

The consistency between the cost/turnover ratios estimated for the panel companies and those from the online survey supports to a certain extent the sufficiency of the panel to establish reliable order-of-magnitude cost ratios across the subsectors and categories of costs. The grossing up by using multipliers that represent the whole population of a particular group (company size and subsector) relies on the hypothesis of full compliance, which however is not always the case. Therefore, in certain cases, it could lead to an overestimation of absolute values.

4 Overview of the relevant legislation

This chapter examines the priority legislation that has high relevance to the chemical industry in terms of cost generation. The legislation in question should incur costs directly to chemical companies. Legislation incurring only indirect costs that are passed on to chemical companies through the prices of inputs (e.g. raw materials, electricity) is not included in the assessment (see section 3.6).

In total, more than 70 pieces of legislation have been identified as important, through the process described in Chapter 3, and were grouped in seven legislation packages on the base of their overarching policy objectives and the types of the associated cost.

The emphasis of the present chapter is on the identification of the types of cost borne by the chemical industry due to specific pieces of legislation.

Legislation within the scope of the study includes regulations, directives, laws or other legal acts in force at any time during the period 2004-2014, even if they were later repealed or amended by other legislation.

4.1 Production steps affected by legislation

Regulatory requirements occur at different levels in a production chain: regulation can impact the cost of raw material and energy, the cost of labour, the cost of equipment and maintenance, the cost of safety and the cost of placing products on the market. Thus, the cost of legislation affecting the chemical industry varies from subsector to subsector and depends on the structure and the complexity of chemicals manufacturing (number of manufacturing steps, type of chemical process and equipment, hazard of chemicals, etc.). Some subsectors are affected by many pieces of legislation and some pieces of legislation require measures that are more expensive than others.

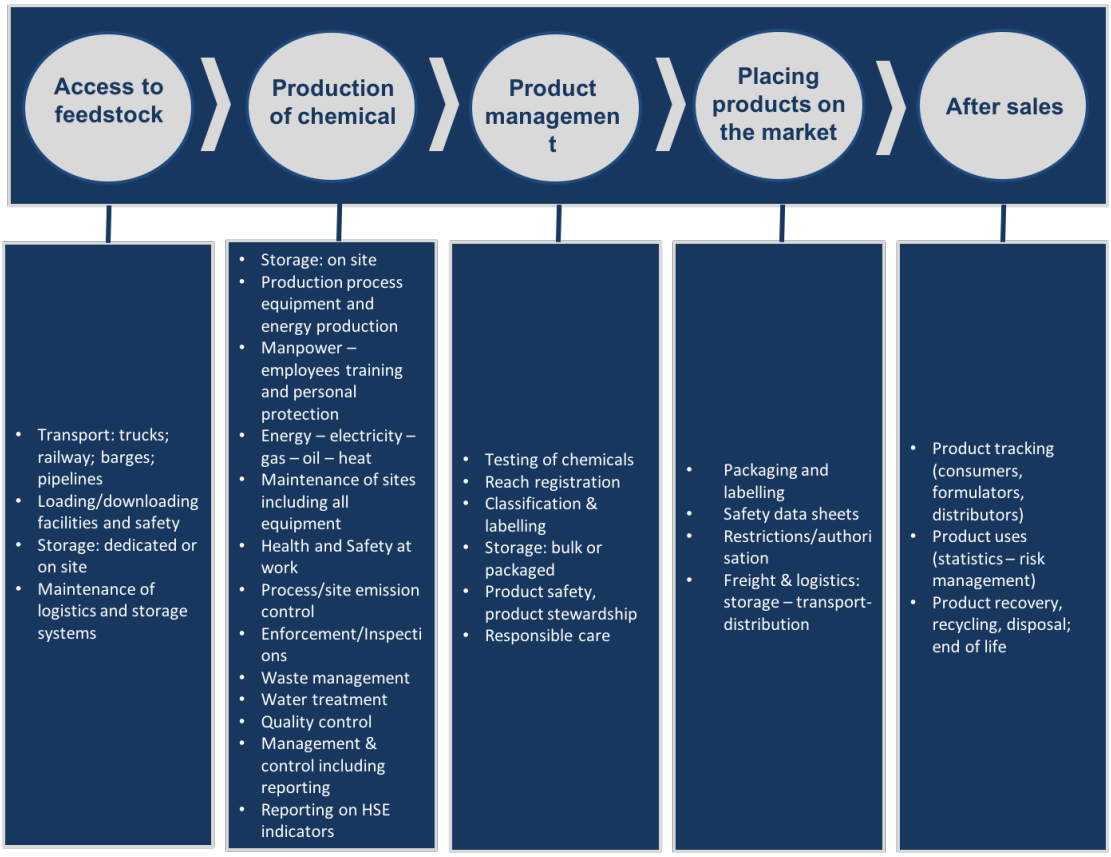
A generic cost structure is presented in Figure 21. The presented cost structure is valid for an entire production chain or for a segment of a more complex production chain where the same structure is repeated. Along complex production chains — from very basic raw materials, such as air or brine, to complex end-consumer products (e.g. complex formulations of several chemicals such as detergents, adhesives, coatings, plastics, rubbers) — the loop is repeated each time a product becomes the raw material of the next transformation step.

Each step in a production chain can be regulated by one or more pieces of legislation. For example, production of chemicals must comply with industrial emissions, energy taxation, Seveso, health and safety at work, air quality, and wastewater treatment. Some pieces of legislation may apply at a specific level in a production chain while others, for example energy taxation or workers' protection legislation, apply at every step along the chain.

Although the costs of legislation will be aggregated per legislation package in a given subsector, there are likely to be differences between subsectors

when comparing the costs of a given piece of legislation, due to differences between production chains.

Figure 21 Generic cost structure of a typical chemical production chain



Source: Authors' elaboration

The impact of the costs of legislation on a given business line also depends on the relative importance of such costs compared to the total cost of production or compared to the added value of the product (cost ratios).

To interpret the relative importance of cost ratios and the differences between them, it is relevant to understand the main drivers of manufacturing costs for the main production chains. Components of chemicals' production costs are multiple (raw material, energy, equipment, labour, etc.) and closely linked to the complexity of production chains.

4.2 Package 1: Chemicals legislation

4.2.1 Overview of the legislation package

The present package includes regulations whose overall objective is to improve the assessment and monitoring of hazards associated with certain chemical substances and to manage the potential risks of using them in certain applications, with a view to protecting human health and the environment.

The main mechanism is through the development of a registration and authorisation system that monitors and controls the introduction into the market of existing or new substances and hazardous products. A classification, packaging, labelling and management system for hazardous substances is also established. Hazards and risks generated by the entry into the market of plant protection substances and biocides are addressed by their own group of legislation within this package.

Before REACH (Regulation No 1907/2006) entered into force in 2007, chemicals used industrially and in consumer products were monitored and controlled mainly by a number of different regulations and directives such as the Existing Substances Regulation (ESR) (Council Regulation No 793/93) on the evaluation and control of the risks of existing substances and the Regulation "Notification of new Substances" (NONS). Under the ESR and NONS regulations, the main responsibility for monitoring and risk assessments was placed upon regulatory authorities, while companies marketing the chemicals had the obligation to provide all the necessary information about their products.

REACH amended or repealed all previous regulations and introduced an integrated system of registration and authorisation for all chemical substances and products containing chemical substances produced or supplied in the EU. REACH assigned technical, scientific and administrative aspects of the implementation of the Regulation to a new EU agency, the European Chemicals Agency (ECHA).

The new principle of 'no data, no market' (Article 5) introduced by REACH is that only substances registered with ECHA are lawful. Thus, companies importing or producing chemicals, in quantities of one tonne or more per year, are responsible for registering the substances either individually or collectively (joint submissions) in a central registry. To obtain the right to market, companies should provide information on the properties of substances, which varies according to tonnages in which the specific substance is manufactured or imported.

The monitoring and authorisation system was complemented by a system of classifications, packaging and labelling regulated by the Dangerous Substances Directive (DSD) (Directive 67/548/EEC) and the Directive 1999/45/EC — classification, packaging and labelling of dangerous preparations and their amending acts. After a transition period, both Directives were replaced by the Classification, Labelling and Packaging (CLP) Regulation 1272/2008, which entered into force in January 2009. The former was repealed in 2010 and the latter in June 2015.

The method of classifying and labelling adopted by CLP is based on the United Nations' Globally Harmonised System (GHS). Any supplier of chemicals must classify, label and package substances and mixtures according to the CLP Regulation. Obligations apply all along the supply chain and each operator (such as manufacturers, distributors, transporters, manufacturers of mixtures) must abide by these rules. When they place a hazardous substance on the market, companies must notify the ECHA of its classification and labelling within one month of placing the substance on the market for the first time. The classification of substances and preparations placed on the market depends on the toxicity and the

hazard of the substance, that is known at the time of registration of the substance. The classification of substances can be reviewed on a voluntary basis or at the demand of authorities.

The continuous efforts of the scientific community to improve the understanding of the potential impact of chemicals on health and environment can cause changes to the harmonised classification of chemicals. Following the adoption of new classifications proposals by the relevant committees of experts and by the European Commission, the revised harmonised classifications are published in Adaptations to Technical Progress (ATP).

In parallel with REACH, especially for persistent organic pollutants (POPs), the Regulation (EC) No 850/2004 of 29 April 2004 sets provisions regarding production, placing on the market and use of chemicals, management of stockpiles and wastes, and measures to reduce their unintentional release.

Risks and hazards of plant protection products (PPPs) and biocides are addressed by a group of legislation comprising:

- Regulation No 1107/2009, which repeals the Council Directive 91/414/EEC, concerning the placing of plant protection products on the market (including daughter or associated legislation on the approved list of substances — Regulation EU No 540/2011, data requirements for active substances — Regulation EU No 283/2013 — and plant protection products — Regulation EU No 284/2013),
- Directive 2009/128/EC on the sustainable use of pesticides, and the Biocides Directive (Directive 98/8/EC) and subsequent Biocide Product Regulation concerning the placing on the market and use of biocide products (Regulation EU No 528/2012).

In addition to all above regulations aiming, among other things, to protect human health, the General Product Safety Directive and Market Surveillance Directive (2001/95/EC) focus explicitly on consumer safety. The main requirement for companies is to inform consumers of the risks associated with the products they supply, and they must take appropriate measures to prevent such risks and be able to trace dangerous products.

Member States have the authority to allow plant protection products to be put on the market. Applications are submitted to the Member State where the product will be placed on the market for the first time. The application goes through an assessment procedure, which could last for up to 12 months involving the European Commission and all Member States. Existing active substances subject to a non-approval decision must be withdrawn from the EU market.

The legislation on pesticides seeks to reduce the risks and impacts of pesticide use on human health and the environment and promoting the use of Integrated Pest Management and of alternative approaches or techniques such as non-chemical alternatives to pesticides. Measures include the training of farmers and advisors, guidelines on Integrated Pest Management, compulsory testing of application equipment, training and certification of all professional users, distributors and advisors, a ban (subject to derogations) on aerial spraying, and special measures to

protect the aquatic environment, public spaces and conservation areas. Member States require sellers of pesticides to provide information regarding the risks for human health and the environment of pesticide use.

All biocidal products require an authorisation before being placed on the market, and the active substances contained in that biocidal product must be previously approved. The approval of active substances takes place at Union level and the subsequent authorisation of the biocidal products at Member State level. This authorisation can be extended to other Member States by mutual recognition. In the latest regulation[16] applicants have also the possibility of a new type of authorisation at Union level (Union authorisation).

4.2.2 Type of cost linked to the legislation package

4.2.2.1 Monetary obligations

All substances registered to ECHA, according to the requirements of REACH, are subject to a fee. The registration fees vary depending on the volume of substances — the higher the volume the higher the fees — and the size of companies — SMEs pay less than large companies.

The CLP Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures foresees that fees are set for requests to use an alternative chemical name and for requests for harmonisation of classification and labelling of substances in the EU. For both fees SME reductions are foreseen for each category of SME (medium, small and micro sized).

The assessment of hazard properties of active substances used for plant protection, and their authorisation under Annex I of the Regulation, is subject to an assessment fee. The placing on the market of plant protection products is also subject to a fee.

Producers of biocides are also subject to registration fees to cover the cost of the procedures associated with the relevant legislation.

4.2.2.2 Administrative burden

The administrative burden includes the cost for the preparation of information dossiers, applications, notifications, or any other information necessary (information obligations) for registration, classification, permission or authorisation of substances. The cost includes the time spent by personnel for the preparation of the registration or authorisation dossiers and the provision of all requested information, as well as

[16] Regulation EU No 528/2012 repealed Directive 98/8/EC.

investments or other costs necessary for the collection or generation of the information such as testing, hiring of consultants or buying data.

During the **pre-registration phase** of REACH**,** the cost was mainly related to the time spent by personnel in familiarising themselves with the requirements and the registration process, and to gather and fill-in the information using the online system.

During the **registration phase,** the cost increases involve the preparation of complex dossiers to provide information that include: substance identity, physicochemical properties, mammalian toxicity, ecotoxicity, and environmental fate (including abiotic and biotic degradation), information on manufacture and uses, and risk management measures. To avoid overspending and duplication of costs, REACH imposes that manufacturers and importers of substances share available data. Each Registrant who manufactures or imports a substance must sell the available data it owns, or purchase data owned by others, by participating in a Substance Information Exchange Forum (SIEF).

The various types of cost are:

- **Personnel cost**: representation at a SIEF, supply chain communication to identify exposure scenarios, data gathering and elaboration, preparation of the chemical safety report or contributing to the costs of preparing the shared components of a registration dossier, production of extended safety data sheets, and supply of revised safety data sheet to downstream customers.
- **External cost**: purchase of data from other members of the SIEF, using consultants to prepare registration dossiers, and contracting certified laboratories for tests.

During the preparation of **restrictions** by Member States or the ECHA, companies need to respond to requests for data, provide inputs or prepare their own submissions of a SEA, and respond to Committee opinions.

Authorisation of Substances of Very High Concern (SVHC) foreseen in REACH legislation requires the interaction of authorities with companies, and the preparation and submission of complex dossiers, which creates the following information obligations for companies: response to Candidate List consultations, preparation of chemical safety assessments and justifications for authorisation, and response to Committee opinions on application.

Authorisation of plant protection products also requires the preparation of (two) dossiers containing all the information available to enable the assessment of potential effects of the plant protection product on human and animal health, and the possible impact on the environment.

Pesticide-related legislation focuses on the distribution and use of the products and thus affects chemical companies who need to retrain their own distribution networks. The information obligations include information dissemination to, and training of, professional users.

Companies also have information obligations under the legislation regulating the classification, labelling and packaging of substances and mixtures (CLP). Their obligations might include the following:

- Preparation of harmonised classification dossiers
- Notification to the C&L inventory
- Informing consumers and downstream users
- Proposing new harmonised hazard classification.

ATPs published under the Dangerous Substances Directive and the CLP for substances and preparations that are already in the market generate additional administrative burden due to the changes in the classification and labelling. Such changes include the preparation of new datasheets and the production and use of new labels.

Legislation related to POPs also generates information obligations to companies. Competent authorities, during the execution of their monitoring and controlling duties, could request information from companies on the production and use of substances controlled by the legislation.

Registration of biocides requires the submission of scientific and technical studies as part of the registration application. The extension of use after 10 years is also subject to approval by and the provision of information to the competent authority. There are also additional information obligations, such as developing safety data sheets, and communicating new information immediately to the competent authority.

4.2.2.3 Substantive obligations

REACH, CLP regulation and their predecessor regulations typically generate costs related to testing, investments in laboratory equipment, labour, labelling equipment, databases, and printing. More specifically, substantive obligations might include capital expenditures and operating cost related to the following:

- Investments in laboratories, measuring and testing facilities
- Replacement or updating of information technology (IT)
- Investments on systems producing labels according to the requirements
- Recurrent upgrades of software and annual staff training
- Staff training to familiarise employees with CLP.

Compliance with POPs legislation requires capital expenditures and operating costs related to:

- monitoring of emissions;
- emission abatement equipment;
- waste management;
- reformulating mixtures;

- changes in conditions of transport, storage and packaging of chemicals.

4.2.2.4 Indirect cost

The generation of indirect cost is often reported in the literature (e.g. CSES 2012, RPA 2009), and is difficult to quantify. Indirect costs are mainly generated when suppliers discontinue the sales of certain chemical substances or the classification of a substance change due to an ATP. In the latter, a substance could be excluded from certain applications or even it would be withdrawn from the market. In such cases, suppliers must propose an alternative substance to their clients or reformulate preparations. Also downstream users of such chemicals seek for alternative substances or reorganise their product portfolios.

Primary sources of indirect cost include the following:

- Substance withdrawal for economic reasons, e.g. registration cost is prohibitively high
- Substance withdrawal due to changes in the classification
- R&D efforts for reformulating preparations due to substance withdrawal
- Supply chain effects, whereby the loss of substances or the increased cost of substances has an impact on activities in the remainder of the value chain, impacting on levels of manufacturing and other activities: e.g. reallocation of activities or the shift of some links of the value chain.

Table 5: Timeline of chemicals legislation

Package 1: Chemicals legislation	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Group 1.a Measures addressing the risks & hazards of chemicals													
Council Regulation (EEC) No 793/93 on the evaluation and control of the risks of existing substances (Existing Substances Regulation - in force before Reach)	○●					●							
Directive 67/548/EEC provisions relating to the classification, packaging and labelling of dangerous substances and amending acts including adaptations to Technical Progress (ATP)	○●												
Directive 1999/45/EC relating to the classification, packaging and labelling of dangerous preparations and subsequent amending acts	○●												●
General Product Safety Directive (Directive 2001/95/EC)	○●												
Accreditation and Market Surveillance Regulation 765/2008						○		●					
POPS Regulation (EC) No 850/2004 and amending acts (EC) No 756/2010[17] and (EC) No 757/2010[18]	○●							○ ●					
REACH Regulation (EC) No 1907/2006				○ ●									
CLP Regulation (EC) No 1272/2008 on classification, labelling and packaging						○	●						

[17] COMMISSION REGULATION (EU) No 756/2010 of 24 August 2010 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes IV and V

[18] COMMISSION REGULATION (EU) No 757/2010 of 24 August 2010 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes I and III

Package 1: Chemicals legislation													
	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Group 1.b Measures addressing the risks & hazards of plant protection products and Biocides													
Regulation (EC) No 1107/2009 and Directive 91/414/EEC concerning the placing of plant protection products on the market	○ ● Dir						○		● ● Dir				
Sustainable Use of Pesticides (Directive 2009/128/EC)							○		●				
Biocides Directive (Directive 98/8/EC) and Biocidal Product Regulation concerning the making available on the market and use of biocidal products (Regulation (EU) No 528/2012)	○ ● Dir									○ Reg	● Reg ● Dir		
Setting data requirements for active substances (Regulation EU 283/2013)											○	●	
Setting data requirements for plant protection products (Regulation EU 284/2013)											○	●	

○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal

Source: Authors' elaboration

Table 6: Prioritisation of chemicals legislation

Package 1: Chemicals legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Group 1.a Measures addressing the risks & hazards of chemicals																
Council Regulation (EEC) No 793/93 on the evaluation and control of the risks of existing substances (Existing Substances Regulation - in force before Reach)	●	●	●	●		●	●	●	●	●	●		●	●	●	●
Directive 67/548/EEC provisions relating to the classification, packaging and labelling of dangerous substances and amending acts including adaptations to Technical Progress (ATP)		●	●	●		●	●	●	●	●	●		●	●	●	●
Directive 1999/45/EC relating to the classification, packaging and labelling of dangerous preparations and subsequent amending acts		●	●	●		●	●	●	●	●	●		●	●	●	●
General Product Safety Directive and Market Surveillance (Directive 2001/95/EC)										●	●			●		
POPS Regulation (EC) No 850/2004 and amending acts (EC) No 756/2010 and (EC) No 757/2010															●	
REACH Regulation (EC) No 1907/2006	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
CLP Regulation (EC) No 1272/2008 on classification, labelling and packaging		●	●	●	●	●	●	●	●	●	●		●	●	●	●
Group 1.b Measures addressing the risks & hazards of plant protection products and Biocides																
Regulation (EC) No 1107/2009 and Directive 91/414/EEC concerning the placing of plant protection products on the market								●						●		
Sustainable Use of Pesticides (Directive 2009/128/EC)								●						●		
Biocides Directive (Directive 98/8/EC) and Biocidal Product Regulation concerning the making available on the market and use of biocidal products (Regulation (EU) No 528/2012)			●					●	●	●						

Package 1: Chemicals legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Setting data requirements for active substances (Regulation EU 283/2013)								●						●		
Setting data requirements for plant protection products (Regulation EU 284/2013)								●						●		

Source: Authors' elaboration

4.3 Package 2: Energy legislation

4.3.1 Overview of the legislation package

The majority of energy legislation in Europe does not target specific sectors or consumers. Although energy legislation does not directly address the chemical industry, it affects the availability and the price of purchased energy and thus is of particular importance for energy intensive industries like the chemical industry whose energy costs can exceed 50% of production costs (Petrochemicals, Chlorine, Ammonia). In addition to the above, energy legislation affects chemical companies producing their own electricity. On-site production of energy is often necessary to ensure appropriate, constant and secure supply of power for continuous manufacturing processes. In this case legislation influencing the production, the distribution and the storage of energy has also an impact on the costs of energy, hence the cost of chemicals manufacturing.

Energy legislation has a **direct impact** on energy costs when chemicals units produce their own electricity, especially if they sell part of their energy (gas or electricity) to the grid. The impact of energy legislation on cost is also **direct** when Member States impose taxes on energy consumption and intensity, on CO_2 emissions of specific energy sources, and levies to fund Renewable Energy support schemes. Although governments use the electricity bill as a vehicle to collect these taxes, they come on top of the energy content of the electricity price.

On the contrary, energy legislation has an **indirect cost impact** when a power producer passes on part of its additional costs, due to the legislation, to chemicals companies purchasing their power from the grid.

Energy legislation that has an indirect impact on cost **is not regarded** as part of the legislation cost and therefore it will not be part of the estimated cumulative cost.

Moreover, energy taxes and excises set by Member States under national taxation schemes are excluded from the cumulative cost assessment.

Therefore, legislation cost estimates include the Renewable Energy Directive (Directive 2009/28/EC), the Energy Taxation Directive (Directive 2003/96/EC), and the Energy Efficiency Directive (Directive 2012/27/EC), including daughter or associated legislation setting implementation measures.[19]

[19] Promotion of COGENERATION based on a useful heat demand in the internal energy market and Directive 2004/8/EC, amending Directive 92/42/EEC on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels, were repealed by the Energy Efficiency Directive with effect in June 2014.

The Renewable Energy Directive 2009/28/EC establishes a common framework for the use of energy from renewable sources in order to limit greenhouse gas emissions and to promote cleaner transport. According to the Renewable Energy Directive, Member States must implement national schemes to develop the production of renewable energy and encourage its use. The mechanism of funding is left to the appreciation of Member States which in most of the cases use taxes and levies included in the energy bill. Levies imposed by Member States vary significantly across Europe.

The requirements of the Renewable Energy Directive may result in direct costs incurred from monetary obligations (renewables levy) charged by Member States via the energy bill.

Similarly, the Energy Efficiency Directive 2012/27/EC establishes a common framework of measures for the promotion of energy efficiency to ensure the achievement of the EU's 20% headline 2020 target on energy efficiency. Member States are to set their own energy efficiency plans for the period 2014–2020 and must submit those to the European Commission.

The provisions affecting companies are the obligation of large enterprises to carry out energy audits. Based on energy audits, companies are asked to invest in equipment that reduces their energy consumption.

National Energy Efficiency measures are implemented on the basis of voluntary agreements, of taxes, or of incentives including subsidies, tax discounts or a pay back of CO_2 certificates.

As a subset of the Energy Efficiency Directive, the promotion of cogeneration — the simultaneous production of electricity and useful heat — by Directive 2004/8/EC affects chemical companies producing their electricity as it requires additional investments for combining heat and power for every electricity generator newly installed on industrial sites with a total thermal input exceeding 20MW.

The requirements of the Energy Efficiency Directive may result in:

- direct costs incurred from substantive obligations for investments in energy monitoring systems, efficient boilers and cogeneration units;
- direct costs incurred from information obligations related to energy audits and to administrative procedures for permits where new power production units are installed.

However, at the same time, companies have a significant incentive to comply with the Directive, as increased energy efficiency leads to energy cost savings.

Although transposition was due in 2014, it was decided to keep this Directive within the scope of the study so as to include any investments made by companies ahead of its entry into force.

The legislation cost estimates also include the Energy Taxation Directive (Directive 2003/96/EC). This directive sets minimum levels for energy taxation related to the energy content and the CO_2 emissions of specific

energy sources. Energy from renewable resources is exempted from this directive. This helps reducing market distortions resulting from national choices on energy sources. It also ensures that the measures adopted under different energy legislation and those adopted under the ETS Directive are consistent with the 2020 objectives to reduce CO_2 emissions by 20%, to increase the use of renewable energy up to 20% and to increase energy efficiency by 20%.

The Energy Taxation Directive provides a framework for the Member States to set their energy-related taxes. However, according to the Commission Staff Working Document on Energy Prices and Costs in Europe (SWD, 2014, 20 final/2), the tax level set by Member States under national taxation schemes is, in most cases, already well above the minimum level set by the Energy Taxation Directive.

4.3.2 Type of cost linked to the legislation package

4.3.2.1 Monetary obligations

Renewable energy levies are charged based on the consumption of electricity. However, there are significant differences across countries and also between subsectors of the chemical industry as some Member States exempt energy-intensive companies from the renewable electricity support levies for competitiveness reasons.

Companies producing their own energy from renewable sources pay a fee in order to obtain a certificate.

4.3.2.2 Administrative burden

The energy audits that large companies are obliged to perform at least every four years incur personnel costs for the organisation, and implementation and documentation of the audit, as well as the cost of hiring external consultants. The first audits should be performed within 2015 and therefore they do not affect the cost during the study period.

The certification process for companies producing electricity from renewable resources generates personnel costs for the preparation of all necessary documentation. Similarly, administrative burden is generated for the preparation of the necessary permits for cogeneration.

4.3.2.3 Substantive obligations

In order for companies to contribute to the indicative energy efficiency targets set by the Member States, investment on equipment could be necessary. Personnel and other operating costs are also added to the initial investment.

Chemical companies producing in-house electricity should invest in equipment combining heat and power, resulting in additional capital and personnel costs for the installation of the co-generators, as well as operating costs during their operation.

4.3.2.4 Indirect cost

Significant cost in the form of energy prices due to EU energy legislation is passed on to companies through the energy prices. However, these costs are not taken into consideration in the study.

Table 7: Timeline of energy legislation

Package 2: Energy legislation	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Energy Taxation Directive (Directive 2003/96/EC)	○●											
Promotion of COGENERATION based on a useful heat demand in the internal energy market and (Directive 2004/8/EC, amending Directive 92/42/EEC on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels - was repealed by the Energy Efficiency Directive with effect in June 2014)		○		●								●
Renewable Energy Directive (Directive 2009/28/EC)							○	●				
Energy Efficiency Directive (Directive 2012/27/EU										○		●
○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal												

Source: Authors' elaboration

Table 8: Prioritisation of energy legislation

Package 2: Energy legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Energy Taxation Directive (Directive 2003/96/EC)			●	●											●	
Promotion of COGENERATION based on a useful heat demand in the internal energy market and (Directive 2004/8/EC, amending Directive 92/42/EEC on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels - was repealed by the Energy Efficiency Directive with effect in 2014)				●												
Renewable Energy Directive (Directive 2009/28/EC)			●	●												
Energy Efficiency Directive (Directive 2012/27/EC)			●	●												

Source: Authors' elaboration

4.4 Package 3: Emissions and industrial processes legislation

4.4.1 Overview of the legislation package

The package includes legislation addressing global warming, emissions, including emissions to air and to water, waste and industrial risks and hazards.

The **EU Emissions Trading System** (EU ETS)[20] is the cornerstone of the European Union's policy to combat global warming and its key tool for reducing industrial greenhouse gas emissions cost-effectively. Launched in 2005, the EU ETS is now in its third phase, currently running from 2013 to 2020. Only a small number of chemical companies were included in Phase 1 and Phase 2 and therefore the cost estimations focus only on Phase 3, where energy-intensive parts of the chemical industry are included in the ETS.

The EU ETS works on the "cap and trade" principle. A "cap", or limit, is set on the total amount of certain greenhouse gases that can be emitted by companies. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances, which they can trade with one another as needed. Although, in Phase 3, auctioning is the default method for allocating emission allowances to companies participating in the ETS (in previous phases the allocation was mainly free), some industries will continue to receive a share of allowances for free until 2020 and beyond. Free allocation is carried out on the basis of benchmarks of greenhouse gas emissions performance. These benchmarks reward best practice in low-emission production.

The benchmark value is set for specific industrial processes such as lime production, olefins production using steam cracking, aromatics extraction, etc. The benchmark value is calculated as the average of the top 10% best performing plants and sets the level of allowances. All facilities in a sector exposed to a significant risk of carbon leakage receive free allowances at the benchmarking value. Facilities emitting greenhouse gases above the benchmark value must purchase their annual emission allowances.

[20] ETS system was set up by the Directive 2003/87/EC, and Phase 3 by the Directive 2009/29/EC. The implementation of the ETS system is regulated by the following daughter or associated legislation: Commission Decision 2010/2/EU of 24 December 2009 determining sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage; Transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (Decision 2011/278/EU); Guidelines on certain State Aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012 (SWD (2012) 131).

Legislation[21] on **industrial emissions** lays down rules for the prevention and control of pollution arising from industrial activities, in order to protect the environment. These rules are designed to prevent or reduce emissions into air, water and land and to prevent the generation of waste.

The relevant regulations set the conditions that industries should fulfil in order to receive permits, and Member States should take the necessary measures to ensure that no installation operates without a permit. The permit should include all the measures necessary to achieve a high level of protection of the environment as a whole and to ensure that the installation operates in accordance with the general principles governing the basic obligations of the operator. The permit should also include emission limit values for polluting substances, or equivalent mitigation measures, emission monitoring equipment and appropriate installations to prevent emissions to air, water, soil and groundwater. The permit conditions including emission limit values must be based on the **Best Available Techniques** (BAT), which are the most effective techniques to achieve a high level of environmental protection, taking into account the costs and benefits.

In addition to the general legislation on industrial emissions (IPPC Directive repealed by the Industrial Emissions Directive), specialised legislation for specific categories of plants and industries also apply[22], as well as emission ceilings for water and air per specific type of pollutant.[23]

Waste management regulations[24] form a distinct category within this package, due to their specific requirements, adding different types of cost.

---

[21] Industrial Emissions Directive (Directive 2010/75/EU), Integrated Pollution Prevention and control, IPPC (Directive 2008/1/EC as codified version of Directive 96/61/EC), Limitation of emissions of VOC from organic solvents (Directive 1999/13/EC), Large Combustion Plants Directive (LCPD) (2001/80/EC), and the Best Available Techniques reference documents (BREFs) adopted by the Commission in the period 2004-2013 (under IPPC Directive and IED five BREFs are directly related to the chemical sector).

[22] E.g.one example of legislation for specific categories of plants is the EU legislation for large combustion plants, Directive 2001/8/EC.

[23] National Emission Ceilings (NEC) Directive 2001/81/EC), Air Quality Framework Directive (Directive 96/62/EC) + (Directive 2008/50/EC), as well as daughter or associated legislation setting implementation measures (European Pollutant Release E-PRTR (Regulation 166/2006), First Daughter Directive (Directive 1999/30/EC) — Sulphur - Nitrogen – particles, Second Daughter Directive (Directive 2000/69/EC) - Benzene – CO, Third Daughter Directive (Directive 2002/3/EC) – Ozone, Fourth Daughter Directive (Directive 2004/107/EC) — PAH's).

[24] Waste Framework Directive (Directive 2008/98/EC) including priority legislation in force at the start of the examined period 2004-2013, namely Landfill of Waste (Council Directive 1999/31/EC), Packaging and Packaging Waste Directive (Directive 94/62/EC), Directive on waste electrical and electronic equipment 2012/19/EU (WEEE), End of Life Vehicle (ELV) (Directive 2000/53/EC).

The Waste Framework Directive (Directive 2008/98/EC) introduces two principles with direct implications on cost:

- The **principle of extended producer responsibility**, which may include the acceptance of returned products and of the waste that remains after those products have been used, as well as the subsequent management of the waste and financial responsibility for such activities. This may also include the obligation to provide publicly available information to the extent to which the product is re-usable and recyclable. Thus, the extended producer responsibility principle leads to direct compliance costs, including substantive administrative burdens due to information obligations.
- The **polluter pays principle** which states that costs of waste management shall be borne by the original waste producer or by the current or previous waste holders, thus leading to substantive obligations.

In addition, legislation in this area sets rules for the production, collection, transportation, packaging, treatment and storage of hazardous waste[25] or specific types of products[26]. These activities should be carried out in conditions providing protection for the environment and human health, including action to ensure traceability from production to final destination and control of hazardous waste, in order to meet the requirements. This will impose information obligations on operators in the chemicals sector, as well as transaction costs with upstream suppliers for tracing purposes.

Under the Seveso Directives[27], companies that produce or use dangerous chemicals are obliged to take all necessary measures to prevent major accidents and to limit their consequences for human health and environment. Compliance with the Directive implies that companies will provide the necessary information to the competent authorities and will invest in the necessary safety equipment and measures preventing accidents.

[25] Waste Framework Directive (Directive 2008/98/EC), Packaging and Packaging Waste Directive (Directive 94/62/EC), Landfill of Waste (Council Directive 1999/31/EC), Directive on waste electrical and electronic equipment 2012/19/EU (WEEE).

[26] Directive on waste electrical and electronic equipment 2012/19/EU (WEEE) which repealed previous WEEE Directive 2002/96/EC and End of Life Vehicle (ELV) Directive 2000/53/EC.

[27] Seveso III Directive (Directive 2012/18/EU) to prevent chemical accidents including priority legislation in force at the start of the examined period 2004-2013 (Seveso II Directive 96/82/EC to prevent chemical accidents).

4.4.2 Type of cost linked to the legislation package

4.4.2.1 Monetary obligations

Purchase of CO_2 allowances under the ETS system is the major source of this package. The cost could vary depending on:

- The market price of CO_2 in the trading system;
- The amount of free allowances accessible in a given year — the higher the amount of free allowances the lower the cost;
- The benchmark value setting the amount of free allowances based on the average best 10% of operators in the sector.

A number of industries falling under the scope of ETS received allowances in excess of their real emissions and banked these to cover further expansion of their production capacity or to generate profits from trading. However, chemical installations were not listed in the annexes of ETS I and ETS II and were therefore excluded from the scope of ETS until the adoption of ETS III. There was thus no banking of allowances due to chemicals production before the adoption of ETS III. One cannot exclude that a limited number of boilers, with a thermal capacity above 20 MW and included in ETS I and ETS II, received some allowances in excess of their real emissions before ETS III. However, under ETS III, a benchmark was also set for greenhouse gases emissions released by boilers for the purpose of delivering steam or heat to chemical production. Therefore, all emissions above the boilers benchmark were subject to auction.

Taxes and fees might apply when waste ends up in landfills, which vary according to national legislation.

4.4.2.2 Administrative burden

The compliance of industry with the EU ETS is managed at the factory level and, therefore, administrative burden is borne by companies.

The administrative burden includes:

- the personnel cost, training for the familiarisation of the system, external expert cost and the investments for the infrastructure that is necessary for the set-up of the monitoring system;
- recurring cost for monitoring, reporting and verification, including personnel cost, operating cost and external cost for verification (consultants, experts etc.).

Similar types of cost are also associated with the issuance, renewal and updating of the environment permits. Administrative burden is also borne during the inspections for checking compliance with the legislation after the issue of permits.

To comply with the waste management legislation, several documents and information should be generated depending on the type of product and the waste management method used:

- preparation of waste documentation for checks at landfill gates;

- provision of publicly available information to the extent to which the product is re-usable and recyclable;
- packaging and labelling of hazardous waste;
- keeping records for the waste management of hazardous products, including information such as the quantity, nature and origin of the waste, and, where relevant, the destination, frequency of collection, mode of transport and treatment method foreseen in respect of the waste.

The need for traceability of hazardous waste, from production to final destination, requires the setting up of relevant procedures and the generation and treatment of information. It could also require investment in equipment.

Under the Seveso Directives, information obligations on companies include providing information on potential hazards, developing a major-accident prevention policy (MAPP), review and update of the MAPP at least every 5 years and sending it to the competent authority, producing a safety report at least every 5 years and after every major accident, drawing up an emergency plan in consultation with staff and testing/updating every 3 years. Most of the costs occur only when the installation is established. During the operation of the facilities most of the cost is associated with updating documents, maintaining equipment and training staff and personnel about safety procedures.

4.4.2.3 Substantive obligations

Substantive obligations resulting from ETS include investments for emission abatement equipment, energy and process efficiency beyond the so-called business as usual. Such investments are made for the purpose of reducing emissions hence improving efficiency and reducing the purchase of emission allowances.

Under the scheme of the Industrial Emissions Directive, companies are required to implement the best available techniques, upon which the environmental permit conditions were based, within 4 years.

Best Available Techniques Reference documents (BREFs) should be reviewed every 8-12 years to ensure they are updated to reflect potential changes in the most performant technique available on the market. BREFs provide descriptions of best available techniques and associated emission limit values.

The National Emissions Ceilings Directive (air quality) sets upper limits for each Member State for the total emissions of the four pollutants (sulphur dioxide, nitrogen oxide, volatile organic compounds and ammonia), but leaves up largely to the Member States to decide which measures to take in order to comply.

The Water Framework Directive dates back to 2000. For some pollutants (mercury, cadmium, hexachlorocyclohexane and discharges of dangerous substances) it sets emission limit values and/or environmental quality standards. Because the legislation is in force since 2000 (the period under

consideration of this document only starts in 2004) this does not go beyond "business as usual" practices. Personnel costs and other operating costs could possibly be associated with eventual initial investments.

To comply with Seveso Directives, investments on safety equipment and measures preventing accidents as well as initial training are necessary.

During the operational phase recurrent operating costs are generated relating to training of personnel and emergency staff and responding to the recommendations of regular inspection every 1-3 years.

4.4.2.4 Indirect cost

Indirect costs, which are not included in the estimates, might result from legal obligations in the form of price increase passed on from suppliers to industrial operators and downstream users. In particular, the costs of:

- ETS incurred by electricity suppliers and industrial operators;
- investments in emission abatement technologies;
- measures regulating waste;
- substitution of hazardous products.

Table 9: Timeline of emissions and industrial processes legislation

Package 3: Emissions and industrial processes legislation	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Group 3.a Measures addressing global warming														
Commission Decision 2010/2/EU of 24 December 2009 determining, sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage								○●					●	
Transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (Decision 2011/278/EU)									○●					
Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012 - (S WD (2012) 131)										○●				
Scheme for greenhouse gas emission allowance trading within the Community (ETS) (Directive 2003/87/EC) up to the Third phase (Directive 2009/29/EC)	○ ETS						● Third phase			● Third phase				
Group 3.b Measures addressing industrial emissions in general														
Limitation of emissions of VOC from organic solvents (Directive 1999/13/EC)	○●							●						
Integrated Pollution Prevention and control, IPPC (Directive 2008/1/EC, codified version of 06/61/EC), replaced by Dire 2010/75/EU, but applicable until January 2014	○●				●							●		
Industrial Emissions Directive (Directive 2010/75/EU)								○			●			●
Group 3.c Measures addressing industrial emissions to air														
Large Combustion Plants (Directive 2001/80/EC)	○●												●	
National Emission Ceilings (NEC) (Directive 2001/81/EC)	○●													
Air quality framework Directive (Directive 96/62/EC and Directive 2008/50/EC)	○●													

Package 3: Emissions and industrial processes legislation														
	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
First Daughter Directive Sulphur - Nitrogen - particles (Directive 1999/30/EC)	○●							●						
Second Daughter Directive Benzene – CO (Directive 2000/69/EC)	○●							●						
Third Daughter Directive - Ozone (Directive 2002/3/EC)	○●							●						
European Pollutant Release E-PRTR (Regulation (EC) No166/2006)				○●		●								
Fourth Daughter Directive PAH's (Directive 2004/107/EC) -	○				●									
Group 3.d Measures addressing industrial emissions to water														
Water Framework Directive (Directive 2000/60/EC)	○●													
Environmental Quality Standards EQSD (Directive 2008/105/EC)						○		●						
Group 3.e Measures regulating waste														
Landfill of Waste (Directive 1999/31/EC)	○●													
Packaging and Packaging Waste Directive (Directive 94/62/EC)	○●													
End of Life Vehicle (ELV) (Directive 2000/53/EC)	○●				●									
Waste Framework Directive (Directive 2008/98/EC)						○		●						
WEEE on waste electrical and electronic equipment (Directive 2012/19/EU)										○		● 2018 fully		
Group 3.f Measures to prevent industrial risks and accidents														
Seveso II Directive to prevent chemical accidents (Directive 96/82/EC)	○●												●	
Seveso III Directive to prevent chemical accidents (Directive 2012/18/EU)										○			●	
○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal														

Source: Authors' elaboration

Table 10: Prioritisation of emissions and industrial processes legislation

Package 3: Emissions and industrial processes legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Group 3.a Measures addressing global warming																
Commission Decision 2010/2/EU of 24 December 2009 determining, sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage	●		●	●	●	●	●								●	●
Transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (Decision 2011/278/EU)	●		●	●	●	●	●								●	●
Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012 - (S WD (2012) 131)	●		●	●	●	●	●								●	●
Scheme for greenhouse gas emission allowance trading within the Community (ETS) (Directive 2003/87/EC) up to the Third phase (Directive 2009/29/EC)	●		●	●	●	●	●								●	●
Group 3.b Measures addressing industrial emissions in general																
Limitation of emissions of VOC from organic solvents (Directive 1999/13/EC)			●	●		●	●									●
Integrated Pollution Prevention and control, IPPC (Directive 2008/1/EC, codified version of 06/61/EC)			●	●		●	●									●
Industrial Emissions Directive (Directive 2010/75/EU)			●	●		●	●									●
Group 3.c Measures addressing industrial emissions to air																
Large Combustion Plants (Directive 2001/80/EC)	●			●	●		●		●						●	

Package 3: Emissions and industrial processes legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
National Emission Ceilings (NEC) (Directive 2001/81/EC)	●			●	●		●		●						●	
Air quality framework Directive (Directive 96/62/EC and Directive 2008/50/EC)	●			●	●		●		●						●	
First Daughter Directive Sulphur - Nitrogen - particles (Directive 1999/30/EC)	●			●	●		●		●						●	
Second Daughter Directive Benzene – CO (Directive 2000/69/EC)	●			●	●		●		●						●	
Third Daughter Directive - Ozone (Directive 2002/3/EC)	●			●	●		●		●						●	
European Pollutant Release E-PRTR (Regulation (EC) No166/2006)	●			●	●		●		●						●	
Fourth Daughter Directive PAH's (Directive 2004/107/EC) -	●			●	●		●		●						●	
Group 3.d Measures addressing industrial emissions to water																
Water Framework Directive (Directive 2000/60/EC)				●		●		●								
Environmental Quality Standards EQSD (Directive 2008/105/EC)				●		●		●								
Group 3.e Measures regulating waste																
Landfill of Waste (Directive 1999/31/EC)						●	●									
Packaging and Packaging Waste Directive (Directive 94/62/EC)						●										
End of Life Vehicle (ELV) (Directive 2000/53/EC)						●	●									
Waste Framework Directive (Directive 2008/98/EC)						●		●								
WEEE on waste electrical and electronic equipment (Directive 2012/19/EU)						●										
Group 3.f Measures to prevent industrial risks and accidents																
Seveso II Directive to prevent chemical accidents (Directive 96/82/EC)				●		●	●			●						

Package 3: Emissions and industrial processes legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Seveso III Directive to prevent chemical accidents (Directive 2012/18/EU)				●		●	●			●						

Source: Authors' elaboration

4.5 Package 4: Workers safety and health legislation

4.5.1 Overview of the legislation package

The package includes four clusters of legislation, addressing workers protection, relevant for the chemical industry: namely the OSH "Framework Directive" on Occupational Health and Safety, *Directive 89/391/EEC 'Introducing measures to encourage improvements in the safety and health of workers at work'* and a series of associated individual pieces of legislation setting implementation measures[28].

The so-called 'Workplace Health and Safety Directive' (Directive 89/391/EEC) sets out general principles for protection of workers' occupational safety and health and contains principles concerning the assessment, prevention and elimination of risks, the protection of safety and health of workers, as well as the informing, consultation and training of workers and their representatives. Other related Directives supplement the "Framework Directive" by defining the standards for safety and health, the measures that should be implemented in various work environments and the information that should be communicated to authorities and workers.

4.5.2 Type of cost linked to the legislation package

4.5.2.1 Monetary obligations

No monetary obligations have been identified in this package.

4.5.2.2 Administrative burden

Administrative burden includes personnel cost for the preparation of audits and carrying out regular health checks.

Implementation of risk assessments and investigations (e.g. for the existence of hazardous, carcinogen or mutagen substances) are required and information on the findings should be communicated to the competent authorities and to workers.

4.5.2.3 Substantive obligations

In order to comply with the health and safety standards and reduce risk, companies need to invest in safety equipment, including personal

[28] Directive 89/654/EEC on Minimum safety and health requirements for the workplace; Directive 89/656/EEC on Use of Personal Protective Equipment; Directive 92/58/EEC on Safety and/or Health Signs; Directive 92/85/EEC on specific measures for Pregnant Workers; Directive 94/33/EEC on Protection of young people at work; Directive 98/24/EC on the protection of workers from the risks related to exposure to chemical, physical and biological agents at work, Directive 2004/37/EC and the subordinate Directives establishing indicative exposure limit values, and Directive 2014/27/EU amending most of the previous Directives.

protective equipment, machinery enclosures or buildings. In addition, personnel and other operating costs for the maintenance and adaptation of equipment to meet the changes in legislation are generated during the operation. Training is also a recurring cost.

Changes in CLP legislation trigger changes in the regulations of this package and thus create additional costs for the adaptation to the new requirements.

Requirements for health and safety are often part of companies' standard and day-to-day practices and therefore they do not bear additional cost. Indicative examples are the requirement for good technical maintenance of the workplace, adequate hygiene conditions or good maintenance of equipment. In all these cases this cost is regarded as "business as usual" and is excluded from the calculations.

Table 11: Timeline of workers safety and health legislation

Package 4: Workers safety and health legislation	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Introduction of measures to encourage improvements in the safety and health of workers at work (Directive 89/391/EEC)	○●												
Minimum safety and health requirements for the workplace (Directive 89/654/EEC)	○●												
Directive on Personal Protective Equipment (Directive 89/655/EEC)	○●						●						
Chemical hazards/risk at work, Chemical Agents Directive (Directive 98/24/EC)	○●												
First list of Indicative occupational exposure limit values, on the protection of the health and safety of workers from the risks related to chemical agents at work (Directive 2000/39/EC)	○●												
Protection of workers from the risks related to exposure to carcinogens or mutagens at work (Directive 2004/37/EC)		○											
Second list of Indicative occupational exposure limit values (Directive 2006/15/EC)				○	●								
Third list of Indicative occupational exposure limit values (Directive 2009/161/EC)							○	●					
Directive 2014/27/EU amending Health and Safety Council Directives 92/58/EEC, 92/85/EEC, 94/33/EC, 98/24/EC and Directive 2004/37/EC in order to align them to CLP Regulation (EC) No 1272/2008												○	●
○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal													

Source: Authors' elaboration

Table 12: Prioritisation of workers safety and health legislation

Package 4: Workers safety and health legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Introduction of measures to encourage improvements in the safety and health of workers at work (Directive 89/391/EEC)	●		●	●	●		●	●	●	●		●			●	●
Minimum safety and health requirements for the workplace (Directive 89/654/EEC)	●		●	●	●		●	●	●	●		●			●	●
Directive on Personal Protective Equipment (Directive 89/655/EEC)	●		●	●	●		●	●	●	●		●			●	●
Chemical hazards/risk at work, Chemical Agents Directive (Directive 98/24/EC)	●		●	●	●		●	●	●	●		●			●	●
First list of Indicative occupational exposure limit values, on the protection of the health and safety of workers from the risks related to chemical agents at work (Directive 2000/39/EC)	●		●	●	●		●	●	●	●		●			●	●
Protection of workers from the risks related to exposure to carcinogens or mutagens at work (Directive 2004/37/EC)	●		●	●	●		●	●	●	●		●			●	●
Second list of Indicative occupational exposure limit values (Directive 2006/15/EC)	●		●	●	●		●	●	●	●		●			●	●
Third list of Indicative occupational exposure limit values (Directive 2009/161/EC)	●		●	●	●		●	●	●	●		●			●	●
Directive 2014/27/EU amending Health and Safety Council Directives 92/58/EEC, 92/85/EEC, 94/33/EC, 98/24/EC and Directive 2004/37/EC in order to align them to CLP Regulation (EC) No 1272/2008	●		●	●	●		●	●	●	●		●			●	●

Source: Authors' elaboration

4.6 Package 5: Product-specific legislation

4.6.1 Overview of the legislation package

The package includes Directives and Regulations that set health, safety and environmental standards for the following products[29]: electric and electronic equipment, construction products, toys, plastic materials and articles intended for contact with food, deco-paints, detergents, cosmetics, ethanol denaturation, fertilisers, explosives, pyrotechnics and tyres.

4.6.2 Type of cost linked to the legislation package

4.6.2.1 Monetary obligations

Monetary obligations are mainly related to the registration or certification cost of some products. For some products, such as pyrotechnic articles, notified bodies must perform a conformity assessment procedure before they issue a certificate. The cost of the certification is borne by the manufacturer.

In the case of alcohol for human consumption, excise duties are charged.

4.6.2.2 Administrative burden

Information obligations are an important aspect of the generated cost by the legislation in this group. The most common requirement across the various pieces of legislation is the issue of a declaration, or an application for a certificate of compliance with the standardised specifications defined in the regulation. The declaration or the application should be accompanied with the necessary documentation, creating costs across the whole supply chain, as all firms contributing to the production of the product should provide the necessary documentation and should be properly certified for their products.

[29] Restriction of Hazardous Substances in electric, electronic equipment RoHS (Directive 2002/95/EC) and RoHS2 extended to medical devices and monitoring instruments 2011/65/EU; Construction Products Regulation (EU 305/2011 and Directive (89/106/EEC); Toys Safety Directive (Directive 2009/48/EC); Plastic materials and articles intended for contact with food (Regulation EU 10/2011 and 202/2014); Deco-Paints Directive (Directive 2004/42/EC); Detergents Regulation (EC) No. 648/2004 as amended (Regulation No 259/2012); Cosmetic regulation No 1223/2009; Ethanol denaturation (EU denaturants) (Regulation 162/2013 and Directive 92/83/CCE); explosives for civil uses (Directive 93/15/EEC); Directive 2004/57/EC (identification of pyrotechnics and ammunition); Directive 2008/43/EC as amended by Directive 2012/4/EC (identification and traceability of explosives); Directive 2013/29/EU; Regulation on Fertilisers (Regulation (EC) No 2003/2003); tyre labelling regulation (1222/2009/EC).

For some products such as cosmetics, the information requirements are quite demanding, as the preparation of a product safety report is required. For cosmetics there are also additional requirements, as companies should notify authorities of their products via the EU Cosmetic Products Notification Portal (CPNP).

Administrative burden, which is mainly labour cost, also occurs during inspections by competent authorities, for example in the case of Deco-Paints.

Proper labelling of the product, indicating the characteristics and the quantity of the regulated substances, is another source of cost under this category. For example, in the case of Deco-Paints the label should clearly indicate the subcategory of the product and the legal limit value for volatile organic compounds (VOC), as well as the maximum content of VOC in the ready to use condition of the product.

4.6.2.3 Substantive obligations

Changes in the standards for products and substitution of materials often require changes in the production methods, testing and the design of products, generating additional capital expenditures, labour cost and operating cost. Even if the final product is not a chemical product (as it is in the case of e.g. plastics, detergents, deco-paints, cosmetics), the changes pass on upstream to the suppliers of the chemical substances, or chemical-based components.

4.6.2.4 Indirect cost

Substitution of substances frequently creates opportunity cost for chemical companies. This is the case when a substance is replaced by a non-chemical component or by substances produced by other companies. In the former there is an opportunity cost for the chemical industry, while in the latter the opportunity cost of one chemical company is compensated by the gains of another chemical company.

Table 13: Timeline of product-specific legislation

Package 5: Product-specific legislation														
	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Regulation on Fertilisers (Regulation (EC) No 2003/2003)	○●													
Ethanol denaturation (EU denaturants) (Regulation (EC) No 162/2013 and Directive 92/83/EEC)	○●										○●			
Construction Products Regulation (EC) 305/2011 and Directive (89/106/EEC)	○●								○		●			
Restriction of Hazardous Substances in electric, electronic equipment RoHS (Directive 2002/95/EC) and RoHS2 extended to medical devices and monitoring instruments 2011/65/EU	○● RoHS								○ RoHS2		● RoHS RoHS2			
Deco-Paints Directive (Directive 2004/42/EC)		○	●											
Detergents Regulation (EC) No 648/2004		○	●											
Tyre labelling Regulation (EC) No 1222/2009							○			●				
Cosmetic Regulation (EC) No 1223/2009							○	●			● fully			
Toys Safety Directive (Directive 2009/48/EC)							○		●					
Plastic materials and articles intended for contact with food (Regulation (EU) No 10/2011 and 202/2014)								○● Reg. 10/ 2011				○● Reg. 202/ 2014		

Package 5: Product-specific legislation															
		Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Explosives	Harmonisation of the provisions relating to the placing on the market and supervision of explosives for civil uses (Directive 93/15/EEC)	○●													●
	Directive 2004/57/EC (identification of pyrotechnics and ammunition)		○●												●
	Directive 2008/43/EC as amended by Directive 2012/4/EU (identification and traceability of explosives)						○	●			○ Dir 2012/4	● Dir 2012/4		● Dir 2012/4	
	Directive 2013/29/EU on the harmonisation of the laws of the Member States relating to the making available on the market of pyrotechnic articles											○		●	
	Commission Implementing Directive 2014/58/EU setting up a system for the traceability of pyrotechnic articles												○	●	●
○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal															

Source: Authors' elaboration

Table 14: Prioritisation of product-specific legislation

Package 5: Product-specific legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Regulation on Fertilisers (Regulation (EC) No 2003/2003)					●											
Ethanol denaturation (EU denaturants) (Regulation (EC) No 162/2013 and Directive 92/83/EEC)										●	●			●		
Construction Products Regulation (EC) 305/2011 and Directive (89/106/EEC)						●										
Restriction of Hazardous Substances in electric, electronic equipment RoHS (Directive 2002/95/EC) and RoHS2 extended to medical devices and monitoring instruments 2011/65/EU				●		●	●									
Deco-Paints Directive (Directive 2004/42/EC)				●					●							
Detergents Regulation (EC) No 648/2004										●				●		
Tyre labelling Regulation (EC) No 1222/2009																
Cosmetic Regulation (EC) No 1223/2009											●			●		
Toys Safety Directive (Directive 2009/48/EC)						●										
Plastic materials and articles intended for contact with food (Regulation (EU) No 10/2011 and 202/2014)				●		●										

Package 5: Product-specific legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Harmonisation of the provisions relating to the placing on the market and supervision of explosives for civil uses (Directive 93/15/EEC)												●				
Directive 2004/57/EC (identification of pyrotechnics and ammunition)												●				
Directive 2008/43/EC as amended by Directive 2012/4/EC (identification and traceability of explosives)												●				
Directive 2013/29/EU on the harmonisation of the laws of the Member States relating to the making available on the market of pyrotechnic articles												●				
Commission Implementing Directive 2014/58/EU setting up a system for the traceability of pyrotechnic articles												●				

Source: Authors' elaboration

4.7 Package 6: Customs and Trade Legislation

4.7.1 Overview of the legislation package

Two Directives are included in the package: Prior Informed Consent Regulation (Regulation (EU) 649/2012) and Drug Precursors Regulation (Regulation (EC) No 273/2004).

The Prior Informed Consent Regulation (PIC) administers the import and export of certain hazardous chemicals and places obligations on companies who wish to export these chemicals to non-EU countries. It implements, within the European Union, the Rotterdam Convention on prior informed consent procedure for certain hazardous chemicals and pesticides in international trade.

Chemicals listed in Annex II are subject to the export notification procedure and to the explicit consent requirement. Also all chemicals that are exported have to comply with rules on packaging and labelling pursuant to the CLP Regulation (EC) 1272/2008 or any other relevant EU legislation.

The Drug Precursors Regulation establishes harmonised measures for the intra-Community control and monitoring of certain substances frequently used for the illicit manufacture of narcotic drugs or psychotropic substances with a view to preventing the diversion of such substances. It defines "scheduled substances" in accordance with Article 12 of the United Nations (UN) Convention. For these scheduled substances, the Regulation contains provisions relating to licences, customer declarations and labelling. The Regulation also places a set of obligations on operators wishing to place on the market substances scheduled as precursors. As such, it is expected that this Regulation will generate substantive obligations and information obligations (administrative burden).

4.7.2 Type of cost linked to the legislation package

4.7.2.1 Monetary obligations

Drug Precursors Regulation obliges operators to obtain a licence from the competent authorities for possession of substances listed in category 1. This requirement imposes monetary costs on the operators wishing to trade with chemicals listed in this Regulation.

4.7.2.2 Administrative burden

According to PIC, exporters in an EU Member State have to notify their intentions to export certain chemicals to a country outside the EU, therefore it is expected that this Regulation will incur information obligations (administrative burden) for the companies wishing to export drugs.

Preparation of the licence application for the substances regulated by the Drug Precursors Regulation generates personnel and testing cost.

Table 15: Timeline of customs and trade legislation

Package 6: Customs and Trade Legislation	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Drug precursors (Regulation (EC) No 273/2004)		○	●										
Prior Informed Consent Regulation (PIC, Regulation (EU) 649/2012)										○		●	
○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal													

Source: Authors' elaboration

Table 16: Prioritisation of customs and trade legislation

Package 6: Customs and Trade Legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Drug precursors (Regulation (EC) No 273/2004)				●												
Prior Informed Consent Regulation (PIC, Regulation (EU) 649/2012)			●	●				●								

Source: Authors' elaboration

4.8 Package 7: Transport Legislation

4.8.1 Overview of the legislation package

Directive 2008/68/EC[30] on the inland transport of dangerous goods applies to the transport of dangerous goods by road, rail or inland waterway within EU countries or between several EU countries. Transport of dangerous goods between Member States, and between Member States and third countries, must comply with the requirements indicated in the Annexes. In the event of an accident where a Member State considers the relevant safety provisions to be insufficient, the Member State must notify the Commission of the measures it proposes to take. If safety is not compromised, Member States may request derogations from the provisions of the Annexes for the transport of small quantities of certain dangerous goods, or where the transport occurs over a short distance or on rail transport on particular designated routes. Once authorised, derogations are valid for a period of 6 years. Member States can request an extension of the derogation. This Directive does not apply to the transport of dangerous goods by the armed forces, by seagoing vessels on maritime waterways, or by ferries crossing an inland waterway.

4.8.2 Type of cost linked to the legislation package

4.8.2.1 Monetary obligations

Issuing certificates for transportation might require fees.

4.8.2.2 Administrative burden

Preparation of the necessary documentation for issuing certificates for transport by inland waterway generates administrative burden.

Labelling of vehicles and containers used for the transport of hazardous substances by road or rail creates administrative burden (cost of label and personnel cost).

[30] The Directive replaces Council Directive 94/55/EC, Council Directive 96/49/EC and Council Directive 96/35/EC and it has been amended by the following: Commission Decision 2009/240/EC of 4 March 2009; Commission Decision 2010/187/EU of 25 March 2010; Commission Directive 2010/61/EU of 2 September 2010; Commission Decision 2011/26/EU of 14 January 2011; Commission Implementing Decision 2012/188/EU of 4 April 2012; Commission Directive 2012/45/EU of 3 December 2012; Commission Implementing Decision 2013/218/EU of 6 May 2013.

4.8.2.3 Substantive obligations

Investments on safety equipment and adaptation of vehicles, wagons and vessels.

Operating cost is related to inspections, maintenance of equipment, vehicles, wagons and vessels strictly related to the safety requirements.

Table 17: Timeline of transport legislation

Package 7: Transport Legislation	Pre 2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Inland transport of Dangerous Goods (Directive 2008/68/EC)						○	●						
○ Adoption ● Transposition or enforcement by competent authorities; ● Repeal													

Source: Authors' elaboration

Table 18: Prioritisation of transport legislation

Package 7: Transport Legislation	Industrial gases	Dyes and pigments	Inorganic basic chemicals	Organic basic chemicals	Fertilisers & nitrogen.	Plastics in primary form	Synthetic rubber	Pesticides & agrochem.	Paints & coatings	Soaps & detergent	Perfumes & toilet prep.	Explosives	Glues	Essential oils	Other chemicals	Man-made fibres
Inland transport of Dangerous Goods (Directive 2008/68/EC)	●		●	●	●			●		●	●					

Source: Authors' elaboration

5 Results of the cumulative cost assessment

This chapter provides an overview of the cumulative cost borne by the selected six EU chemical industry subsectors due to the selected EU legislation. In addition to the chemical subsectors some data from existing sources on the subsector wholesale of chemical products are presented, which provide only a broad overview of the cost.

The costs have been estimated based on the methodology presented in Chapter 3 for each of the legislation packages presented in Chapter 4.

When all legislation relevant to chemical companies is cumulated, the estimated **average annual total direct cost** for the six subsectors covered by the study during the period 2004-2014 approaches €9.5 billion, representing 2% of their turnover and 12% of the value added. Comparing cost with the Gross Operating Surplus (GOS), which can be used as a proxy for profit, the cost represents as much as 30% of this value, indicating that legislation cost is among the important factors shaping the profitability of the chemical industry.[31]

In addition to the estimated cumulative cost, companies also bear indirect legislation costs passed on to them through energy, feedstock and other inputs (e.g. machinery), as well as transaction and opportunity costs which are not included in the above number. Although the issue of indirect cost was raised during the interviews, it has not been included in the assessment as it is explained in the methodology chapter (see section 3.6).

5.1 Cumulative cost assessment by legislation package

5.1.1 Overview of cumulative cost

Among the legislation packages, three clearly stand out as the main drivers of legislation cost, namely: emissions and industrial processes, generating 33% of the cost; chemicals, accounting for 30%; and workers' safety and health, with 24% (Figure 22).

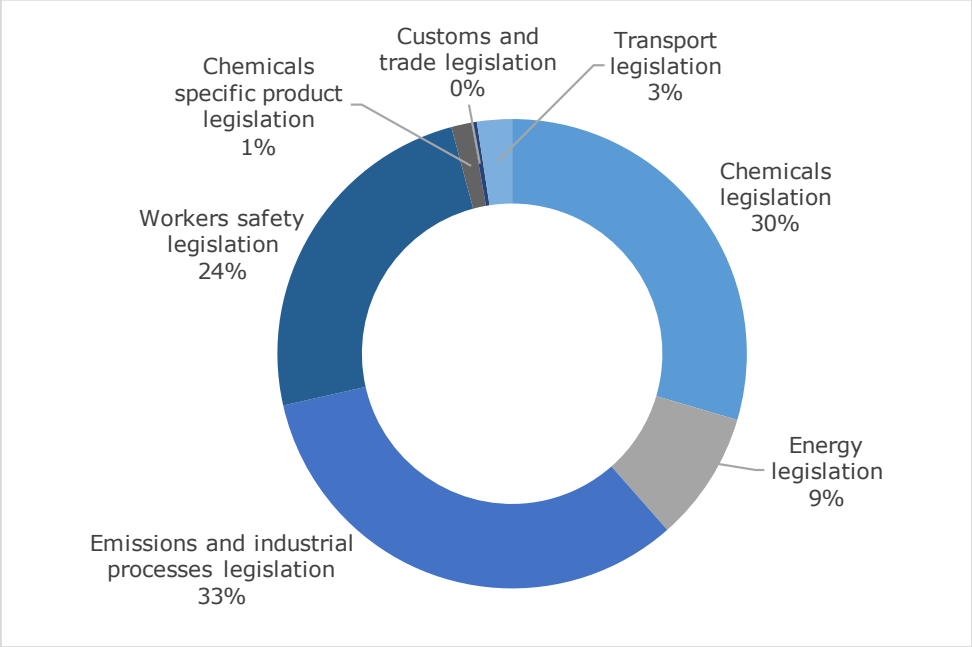
The importance of the legislation packages varies across sectors (Table 19 and Figure 23). The emissions package is the most important package for three subsectors, namely: inorganic basic chemicals (7% of value added), pesticides and other agrochemicals (7%), and organic basic chemicals (5%). The chemicals legislation package is by far the most important for

[31] The figure is comparable with the finding in other industries such as aluminium and steel. According to the CCA study for aluminium (CEPS, 2013b), cumulative cost as a percentage of profit varies between 23% in 2006 (the most profitable year) and 242% in 2011 (the year with the lowest positive profit value).

pesticides and other agrochemicals (13%), followed by specialty chemicals (7%), and soaps and detergents (6%). Workers' safety and health legislation is less important than the other two for all sectors except specialty products, where it is the second most important package (5%).

A detailed analysis of the cost by legislation package is presented in the following sections.

Figure 22: Contribution of legislation packages to the total legislation cost — average annual share in total cost 2004–2014



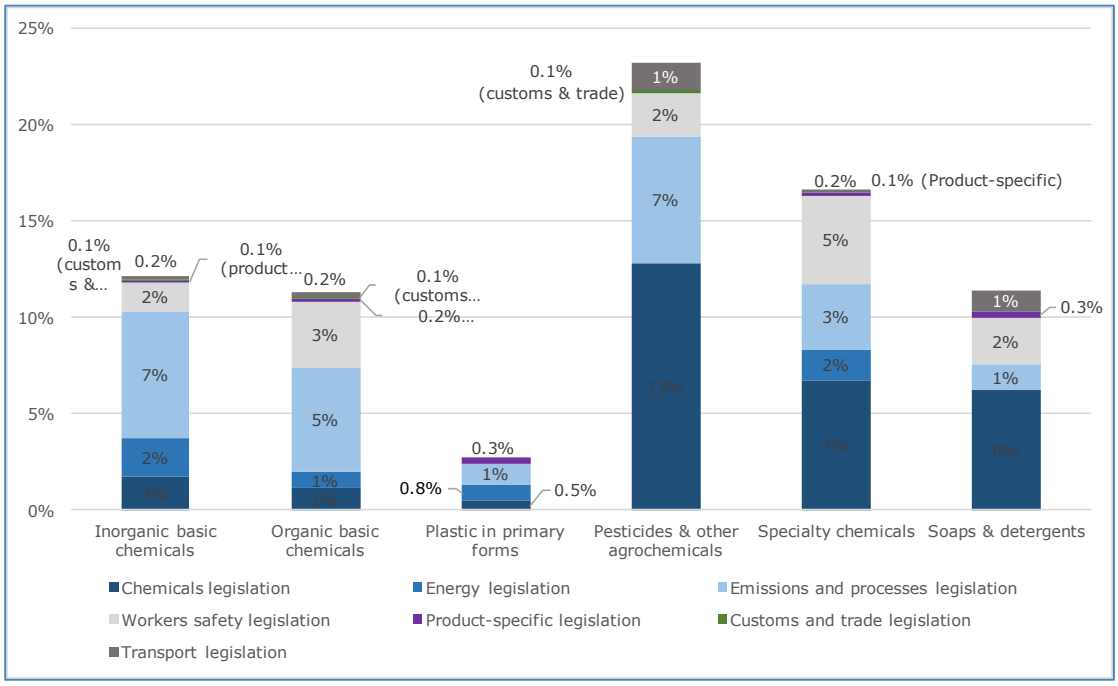
Source: Authors' elaboration

Table 19: Cumulative cost of legislation packages by subsector — share of value added and average values in € billion per year, 2004–2014

Legislation packages	Share of value added							Total in € billion
	Inorganic basic chemicals	Organic basic chemicals	Plastics in primary forms	Pesticides and agrochemicals	Specialty chemicals	Soaps and detergents	Total	
Chemicals	1.7	1.1	0.5	12.8	6.8	6.2	**3.5**	2.8
Energy	2.0	0.9	0.8		1.6		**1.1**	0.9
Emissions and industrial processes	6.6	5.4	1.1	6.5	3.4	1.3	**4.0**	3.1
Workers safety and health	1.5	3.4	0.0	2.3	4.6	2.4	**2.9**	2.3
Product specific	0.1	0.2	0.3	0.0	0.1	0.3	**0.2**	0.1
Customs and trade	0.1	0.1	0.0	0.1	0.0	0.0	**0.0**	0.0
Transport	0.2	0.2	0.0	1.4	0.2	1.1	**0.3**	0.2
Total	**12.1**	**11.3**	**2.7**	**23.2**	**16.7**	**11.4**	**12.0**	**9.5**

Source: Authors' elaboration

Figure 23: Cumulative cost per subsector and its composition by legislation package – annual share of value added 2004–2014



Source: Authors' elaboration

5.1.2 Cumulative cost of the chemicals package

This package groups different legislation addressing chemical hazards and safety, and the conditions for placing chemicals on the market (see Chapter 4). The overall average annual cost associated with the chemicals package over the period 2004-2014 amounts approximately to €3 billion. In relative terms, the cost is around 3.5% of the subsectors' value added.

Comparing the various cost categories, administrative burden and monetary obligations together account for more than 50% of the cost.

The main contributors to monetary obligations and administrative burden are REACH, PPPs and biocides-related Directives, while the main source for CAPEX and OPEX is CLP regulation.

Administrative burden corresponds to the amount of work necessary to fulfil information obligations, run tests to perform hazard and risk assessments, retrieve data on applications from downstream users, monitor emissions data, or prepare technical dossiers for the purpose of registration, authorisation, classification and labelling.

Table 20: Composition of the cost of the chemicals legislation package, by cost category — annual average for the period 2004–2014

Cost category	Share of VA (%)	Share in package's cost (%)
Monetary obligations	0.9	26
CAPEX	1.0	29
OPEX	0.7	20
Administrative burden	0.9	26
Total	**3.5**	**100**

Source: Authors' elaboration

The average annual cost for REACH, including both registration fees (monetary obligations) and cost of preparation of dossiers (administrative burden) is estimated at around 0.8% of companies' added value and less than 0.2% of their turnover for the period 2008-2014.

When comparing the two components of the cost, registration fees exceed slightly the cost for preparation of dossiers, which amounts approximately to 54% of the total cost of registration. A similar percentage is also reported in the Interim Evaluation of REACH (Centre for Strategy and Evaluation Services, 2012b p.60) which estimated that "registration fees can represent up to 50% or more of the total costs, especially in the case of rather simple substances when the second important cost element, costs of data or letters of access, are in the low range of €5,000-10,000."

A very rough estimation of the average annual cost in monetary terms is approximately €650 million. The cost could be overestimated due to the method used for the grossing up. However, the estimated cost falls within the broad range of cost reported in the interim evaluation of REACH. According to the interim evaluation, the cost of REACH (including registration fees and preparation of dossiers) for all companies subject to REACH is within the range €1.1 billion to €4.1 billion for the period 2008–2011. In annual terms, the range is between €275 million and €1 billion, with the most probable annual cost around €525 million, if the median cost per registration is used, or €850 million if the average cost is used. The cost mentioned above does not include any additional testing subject to approval by ECHA, which however has been included in the CCA study. However, in the latest evaluation report on REACH (CSES, 2015) the estimated total costs of the 2013 registration were of the order of €459 million which is lower than the cost estimated in the other studies.

In addition to the above costs, opportunity cost should be also considered, although quantification cannot be provided. Interviews with the panel companies corroborate the findings of the interim evaluation (Centre for Strategy and Evaluation Services, 2012) that registration cost (both registration fees and information obligations) is the most common reason for the withdrawal of a substance or the decision to reduce production below 1,000 tonnes per year. The placement of a substance in the candidate list for authorisation is also a reason for withdrawal, mainly as a response to requests by producers or retailers of final products.

REACH registration cost will continue until all substances in the third volume band (1-100 tonnes annual production volume) are registered by the registration deadline in 2018. Registration fees, and the costs of studies requested to register low tonnage substances, are lower compared to the previous tonnage bands, but the number of substances in the third volume band will be much higher. The ECHA roadmap 2018 does not forecast a precise number of registrations. However, ECHA's website declares that "this final deadline is expected to generate the highest number of registrations and there will also probably be far more inexperienced registrants" (ECHA, n.d a). This indicates that the cost for the industry will not decrease before 2018. After 2018, one can expect that REACH registration cost will disappear while costs associated to restrictions, authorisations and substitution of chemicals will continue.

The findings of this study and of the interim evaluation are significantly higher than those of the ex-ante impact assessment of REACH performed in 2003 (European Commission, 2003). According to the latter, the total estimated cost could reach around €2.3 billion in 2003 values (€2.6 billion

in 2011 values)[32] for the 11-year period. The main reasons for the deviation, according to the Centre for Strategy and Evaluation Services (2012) are the following:

- The ex-ante impact assessment was expecting a wide use of QSARs (Quantitative Structure Activity Relationship), an approach for hazard and risk assessment that relies on modelling rather than testing, which could significantly reduce the cost but has a limited use in the preparation of dossiers.
- The fees paid by firms for getting access to existing studies were not considered in the impact assessment.

At this point, two parameters should be mentioned which need to be considered when comparing various studies. The *first* issue is that a precise and direct comparison between the findings of this study and those of the interim evaluation of REACH or other related studies is difficult due to the use of different classifications for companies. While the current study follows the NACE classification, REACH-related studies usually use classifications that distinguish companies by their role in the value chain, namely: manufacturers, formulators, importers and distributors.

The *second* issue is that all studies on REACH limit their scope to the administrative and registration cost. However, as the interviews indicate, some companies also invested in the expansion of existing or setting up of new testing facilities instead of subcontracting the testing to external laboratories. Investing into testing facilities and equipment could be a decision dictated by company's broader strategy or due to the lack of the required testing capacity in external laboratories. In the case of companies investing in their own testing facilities, the cost of such investments have not been considered by the interim evaluation or the impact assessment study, so the reported cost could be underestimated. The current study has included those investments under CAPEX, although the granularity of the information provided by companies did not allow for defining the portion of CAPEX that is strictly related to REACH and those associated to CLP.

Legislation related to plant protection products, biocides and CLP also generate administrative and monetary obligations that approximately correspond on average to 1% of the value added of all companies in the six subsectors. However, if the cost is compared with the value added of companies subject to the above legislation — and especially those placing plant protection products on the market, such as pesticides and other

[32] The cost in 2011 values has been estimated in Centre for Strategy and Evaluation Services (2012).

agrochemicals (C20.20) — then the share of cost is much higher. Specifically for C20.20, the share amounts to 4.6%[33] of the value added.

Compared to REACH, legislation on Plant Protection Products and on Biocides generates higher monetary obligations per active substance or per formulation placed on the market. Two reasons explain the higher monetary obligations: first, the registration fees for active substances are much higher compared to REACH; second, each formula containing active substances must be registered and authorised separately at Member State level.

With the exception of amounts invested in testing equipment and facilities, a large part of the costs reported under CAPEX and OPEX must be attributed to CLP obligations and correspond to investments in IT systems, printing equipment, software for product labels and safety data sheets associated with products placed on the market. CAPEX and OPEX costs amount to 1.7% of value added. However, it was not possible to estimate the CAPEX and OPEX cost for each specific piece of legislation on the basis of the information provided by the companies. The CLP-related cost is expected to significantly decrease after 2015 as this is the deadline for all hazardous chemicals to be labelled and packaged according to CLP, with the exception of the mixtures that have already been classified, labelled and packaged under the DPD. Such mixtures will only have to be labelled and packaged in accordance with CLP by 1 June 2017 (ECHA, n.d b). Therefore, an additional reduction of costs is expected after 2017.

According to the ex-ante impact assessment performed by the UK government (DEFRA, 2011), the transposition of the 1107/2009 Directive for PPPs would increase the registration cost for the industry in the UK from €1.7 million to €2.4 million per year, resulting in an annual increase of 41% compared to the existing Regulation (91/414/EEC). The estimation is based on the hypothesis that all UK authorities' enforcement cost will be passed on to companies. Assuming the same fees for all countries and a total cost per country proportional to the size of the pesticides and agrochemicals market, the monetary obligations for companies after the transposition of the PPP Directive will increase from €14.4 million to €20.3 million per year.[34] However, this cost does not

[33] The share of administrative burden and monetary obligations in the total cost generated by the chemicals legislation package for C20.20 is 65% (see Figure 36 in section 5.3.4). The cost of the chemicals legislation package amounts to 12.8% of C20.20 value added (see Table 29 in section 5.3.4). Then assuming that the proportion of CLP, PPP and biocides legislation in the administrative burden and monetary obligations of the six subsectors which amounts to 55%, is the same also for C20.20, the share of the three legislations' administrative burden and monetary obligations cost in the value added of subsector 20.20 is 12.8%x0.65x0.55=4.6%.

[34] The rate UK/EU of value added of sector C20.20 (1/8.474) has been used for the estimation of the cost of fees for the EU.

reflect the costs associated with the preparation of the technical dossiers for registration and authorisation (information obligations).

The impact assessment on the Biocides Directive (European Commission, 2009) estimates that administrative burden for industry resulting from the implementation of the Directive 98/8/EC until 2012 would be approximately €2.9 billion, while the administrative burden of Regulation 528/2012 for the next 10 years (starting from 2013) would be around €1 billion. When combining the cost of the two pieces of legislation over the period covered by this study, the annual cost amounts approximately to €175 million.

The ex-ante impact assessment of CLP (European Commission, 2007) provides estimates for one-off investments and expenditures necessary for the transition from the old system to the new one. Cost includes investments in IT systems, corresponding training, reclassification cost, workability costs of prematurely classifying mixtures, the cost of operating two parallel systems during the transition, etc. The one-off cost for a transition period of five years is estimated to be around €527 million and includes CAPEX and administrative burden. The assessment assumes that OPEX are similar for both systems and therefore no estimation is provided.

Although a direct comparison is very difficult, given the fragmentation of information and the different time frames and methods of assessing the cost, the figures provided by the ex-ante impact assessments rather underestimate the total cost. Among the factors that have been overlooked are CAPEX and OPEX, which have been only partly estimated (with the exception of CLP), and the cost of changes in classification and labelling as a result of ATPs.

Beyond one-off costs associated with changes in the classification and labelling system, additional costs arise when the classification of substances or preparations is revised due to the issue of an ATP. A total of 31 ATPs have been published under the Dangerous Substances Directive (DSD) (Directive 67/548/EEC) and six ATPs were published under the CLP Regulation. Changes in classifications always trigger a cascade of adaptations of risk management measures associated with substance hazards. The impact goes beyond the boundaries of the chemicals package, potentially affecting the compliance with Seveso or the workers' health and safety legislation. Among the potential changes are adaptations of industrial equipment (containment or abatement systems), storage vessels, packaging, transport, occupational exposure limit values, workers' protection measures, emergency plans, and ultimately marketing and use restrictions, authorisation and substitution. Costs associated with these changes include:

- substantive obligations (CAPEX – OPEX – Recurrent training – financial charges), including potential reformulation and substitution costs;
- information obligations (administrative burden);
- opportunity costs when substances or products are removed from the market.

Measuring the impact of ATPs on cost is not feasible within the context of this CCA. The effect of an ATP is narrowed to specific products, and therefore, changes in cost can be observed only in specific companies which are not necessarily "typical companies" of their subsector. In order to address the issue, a more focused approach is necessary targeting the specific product groups and the affected companies. Some of the enterprises of the soaps and detergents industry participating in the panel of this study have been affected by changes in the classification of concentrated detergents where changes in the packaging and labelling were necessary. However, the observations were not sufficient to conclude on the impact of ATPs on legislation cost.

5.1.3 Cumulative cost of the energy package

Companies, being energy consumers, are subject to taxes and levies that are often collected through the electricity bills, although they are not part of the energy content of the electricity price. Companies producing their own electricity are also subject to taxes. All other costs that are passed on through energy and fuel prices have not been taken into consideration. EU legislation in the energy field can somehow provide a framework for the Member States to set their taxes and subsidy systems. According to the Commission Staff Working Document on Energy Prices and Costs in Europe (SWD, 2014, 20 final/2) the variability across countries regarding the taxes and the subsidies is significant. There are substantial differences among the Members States in the composition of levies and taxes imposed on industrial energy consumers, reflecting different policy choices as regards renewable energy, energy efficiency, or energy taxation.

On average at EU level, taxes accounted for around 18% of electricity ex-VAT prices in 2012, having increased from 9% in 2008. In 2008, taxes varied from 0.5% in Slovakia to 16% in Italy. In 2012, the lowest share of 2% was observed in Bulgaria, the Czech Republic, Croatia, Lithuania and Sweden, while it reached 32% in Germany. Along with the country differences, variability is also observed across industrial sectors within countries due to reimbursements and exemptions available to specific sectors. As a result, in several Member States, tax levels under national taxation schemes are significantly higher than the minimum level set by the Energy Taxation Directive.

The overall average cumulative cost for subsectors impacted by energy related legislation is less than €1 billion per year. To put this number in perspective, Eurostat published a figure of €3.3 billion for energy taxes paid by the chemical industry (NACE C20) (Eurostat, 2015c) in 2012. [35]

[35] The above figures do not include France, Sweden, Estonia, Croatia, Austria and, Luxembourg, Malta or Cyprus.

Approximately 69% of the €1 billion cost represents energy taxes and levies paid by companies either as consumers of energy or as producers. However, **this amount does not differentiate between EU and national policies,** as it was not possible to make such distinction. The Commission is preparing a Report on Energy Prices and Costs in Europe, which will investigate the determinants of energy price formation, including the role of energy taxes and levies.

A small amount of the monetary obligations regards fees for certificates, and it is borne by companies producing their own electricity by using renewable energy sources. Acquiring certificates also generates administrative burden that is, however, negligible.

Table 21: Composition of the cost of the energy legislation package, by cost category — annual average for the period 2004–2014

Cost category	VA (%)	Share of package cost (%)
Monetary obligations	0.8	69
CAPEX	0.1	13
OPEX	0.2	14
Administrative burden	0.0	4
Total	**1.1**	**100**

Source: Authors' elaboration

Investments by companies in equipment to reach the energy efficiency targets set by the Member States and investments into the cogeneration by companies producing electricity in-house represents around 0.1% of value added. The operating cost for the operation and maintenance of the investment also represents 0.1% of value added.

Typically, such investments include energy audit, energy monitoring systems, schemes to reduce energy consumption, efficient boilers, new burners, heat recovery units, co-generation units, renewable energy units etc. Energy intensive industries such as several subsectors of the chemical industry invest regularly to increase energy efficiency and reduce energy consumption. The chemical industry has already been able to reduce its energy consumption per unit of production by 41% between 1995 and 2008 through voluntary measures. However, some observers argue that a further increase of energy efficiency with current technological possibilities is limited within the chemical industry as there is a strong reliance on fossil fuels as raw material in energy intensive subsectors (Ecofys, 2013).

5.1.4 Cumulative cost of the emissions and industrial processes package

The cost of the emissions and industrial processes package amounts to approximately €3 billion per year. The main sources of cost are the investments and the associated operating costs that are necessary for

reducing emissions (including CO_2) and to comply with the requirements of permits, which insist on the use of 'best available techniques' (BATs), which are the most effective techniques to achieve a high level of environmental protection, taking into account the costs and benefits.

Monetary obligations represent 0.6% of the value added and include mainly the purchases of CO_2 allowances under the ETS system. Purchase of CO_2 allowances will increase over the years as the number of free allowances reduces over time. Industry exposed to carbon leakage benefits from free allowances up to the level of the benchmark set as the average of the 10% best performance. Emission allowances above the benchmark are purchased at a value set by auction on the carbon market. The above figure of 0.6% reflects a low CO_2 price and an excess of CO_2 allowances available on the auction market. The ratio will gradually increase with the reduction of the cap. Monetary obligations associated with permits could not be identified. Differences across the EU28 are not noticeable for monetary obligations.

Table 22: **Composition of the costs of the emissions and industrial processes legislation package, by cost category — annual average for the period 2004–2014**

Cost category	Share of VA (%)	Share of package cost (%)
Monetary obligations	0.6	15
CAPEX	2.6	66
OPEX	0.6	16
Administrative burden	0.1	3
Total	**3.9**	**100**

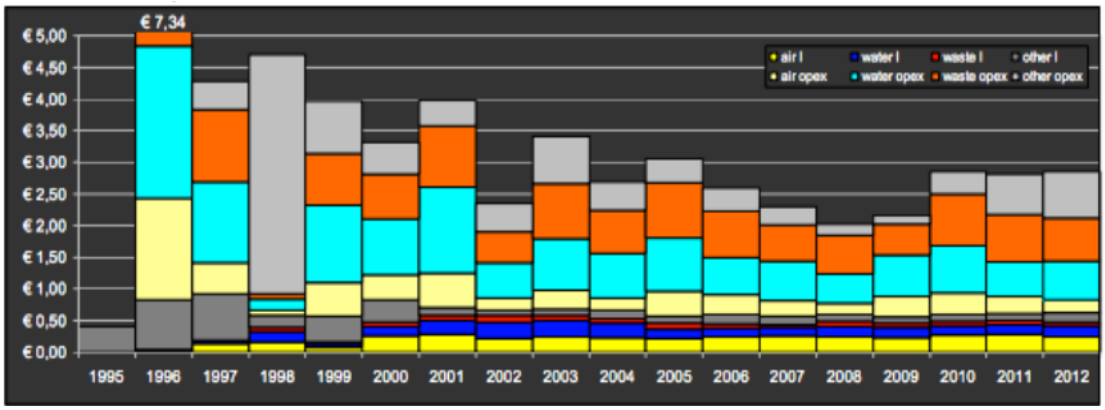
Source: Authors' elaboration

Overall CAPEX and OPEX amounts to 3.2% of the subsector's value added. CAPEX and OPEX identified in this study result from investments in emission monitoring devices, in emission abatement systems such as waste water treatment, scrapping of industrial emissions, particulate matters and sulphur removal units, catalytic convertors of NOx and VOC, Seveso related containment systems, emergency plans, and installation or upgrades of best available techniques.

In a recent study of the European Commission (Jantzen & van der Woerd

2015) based on Eurostat data, it is estimated that CAPEX and OPEX to address the environmental protection objectives of companies in the sectors Chemicals and chemical products (C20), Pharmaceuticals and pharmaceutical products (C21), and Rubber and plastic products (C22) in 2012 amounted to 3% of their value added. Since the scope of Eurostat statistics is not directly comparable with the scope of this study, adaptation was necessary to compare data sets in a meaningful way.[36] Once the differences are taken into account, the adapted CAPEX and OPEX, based on the data from this study, including Seveso-related expenditures, amounts to 3.7% of value added. Even after the adaptation, the estimations of the two studies remain close. However, differences are observed in the trend for the period 2004-2007 where Eurostat figures are higher than the figures of this study (Figures 24 and 26).

Figure 24: Relative environmental expenditures (CAPEX and OPEX) of the chemical industrial sector (NACE C20-C22) per €100 value added, 1995–2012



Source: Jantzen & van der Woerd (2015) Figure 6.7.

[36] The fact that both studies estimate the cost as a share of the value added allows a direct comparison between the two. However, adaptation is necessary to better align the type of costs measured by the studies: 1) Eurostat statistics include expenditures on energy efficiency while this study has allocated them in the energy legislation package. 2) Eurostat includes information obligations regarding the compliance with environmental legislation in OPEX. In this study, they are included in the category of administrative burden of the emissions package. 3) Seveso related expenditures are not included in Eurostat's figures while they are included in this study. Although there are no sufficient data for estimating a specific figure, CAPEX and OPEX related to Seveso represent a sizable portion of the emissions package in this study.

If the above costs are added, CAPEX and OPEX estimated in this study are increased to 3.7% of the value added minus CAPEX and OPEX due to Seveso.

Taking into consideration that Figure 24 presents cost as a share of value added for the whole chemicals sector (C20-C22), while Figure 26 is an index of the annual changes in the cost per turnover of only six subsectors of C20, the following observations can be made. According to Eurostat, the trend is U-shaped over 2005-2012, with the lowest value observed in 2008 and the highest values at around 3% of value added in 2005 and the period 2010-2012. The values in the current study present a continuous growth starting from a low point in 2005. However, the trends after 2008 are very similar, with the same peaks and turning points. The lower level of costs in this study at the beginning of the period can be related to the increasing uncertainty related to past costs due to the collection of data at a single point in time (2015) compared with the Eurostat data which are collected at several time intervals.

Administrative burden is the lowest of all cost categories, amounting to 0.1% of value added. The primary source of cost is the obligation of reporting and the preparation of companies for inspections. Although the latter impacts mainly public authorities, there is also some personnel cost borne by companies.

The review of permits as such hardly incurs any administrative burden as permits have only to be updated within four years after publication of a new BREF. On average BREFs are reviewed every 8-12 years. The estimated update frequency resulting from the legislation would thus be around once every 10 years.

Chemicals producers highlighted national differences in the conditions for granting permits. The rule set by the Industrial Emission Directive is to issue a permit for new installations or extended capacity based on the best available technique. In such cases, some Member States use a pragmatic approach to take into account local constraints. As an example, when the configuration of a production unit is not adequate to install the best available technique, compromises are negotiated to grant permits based on the second- or third-best available technique, with the condition to install other systems to compensate the lower performance and ensure compliance with the desired objective. Another example demonstrates the way industrial emissions are managed and controlled: in some countries, industrial emissions are addressed by emission point, in others the concept of 'bubble of emissions' is applied to a whole production site. The two above examples illustrate the existing diversity among Member States, which might also be a source of differences in costs.

5.1.5 Cumulative cost of the workers' safety package

The average cost of the workers' safety package amounts approximately to €2 billion per year.

The main cost drivers are the operating cost and the investment related to the improvement of safety conditions and protection of the health of workers. The yearly cost borne by companies remains stable over the period covered by the study, as there are no significant changes in the legislation. However, changes in processes, product formulations or classification of substances can require updates of safety standards in

place at a manufacturer's site. As an example, when a substance classified as hazardous is introduced in a chemical process, the manufacturer must implement measures such as individual protective equipment, emission control systems, emission abatement measures including ventilation or closed systems, bio-monitoring of workers and safety training. Changes in the classification of substances trigger adaptations in the workers' protection measures. Investments in safety measures are usually one-off at the start of a plant and changes are limited to upgrades or expansion of facilities. Overall CAPEX is kept at around 0.8%. On the other hand, operating costs recur on an annual basis and amount to approximately 2% of the value added. Operating costs include periodic maintenance of safety systems, regular replacement of individual protective equipment (overwear, gas mask, goggles, gloves), bio-monitoring and training of workers.

Table 23: **Composition of the cost of the workers safety and health legislation package, by cost category — annual average for the period 2004–2014**

Cost category	Share of VA (%)	Share of package cost (%)
Monetary obligations	0.0	0
CAPEX	0.8	28
OPEX	2.1	72
Administrative burden	0.1	3
Total	**2.9**	**100**

Source: Authors' elaboration

The data collected though the study did not highlight noticeable differences across Member States.

5.1.6 Cumulative cost of product specific, customs and trade and transport packages

Altogether product specific, customs and trade and transport legislation packages account for only 4% (€0.4 billion per year) of the legislation cost of the six subsectors representing 0.5% of the value added.

Among them, the transport package generates more than half of the cost, amounting approximately to 0.3% of value added (Table 24). The cost generated by this package is driven by Directive 2008/68/EC on the inland transport of dangerous goods and mainly concerns OPEX (57%) related to the maintenance of safety equipment, vehicles, wagons and vessels.

Cost generated by the product specific legislation package represents 17% of the value added, with primary cost components CAPEX and OPEX (31% and 34% respectively of the package cost). The package includes several pieces of legislation focusing on very different families of products. Interviewed companies were not in a position to itemise the cost by piece

of legislation. However, the regulation on fertilisers, deco-paints and the detergents regulation were mentioned more often as the primary drivers of cost.

Table 24: Composition of the costs of product-specific, customs and trade, and transport legislation packages, by cost category — annual average for the period 2004–2014

Cost categories	Product-specific		Customs and trade		Transport	
	Share of VA (%)	Share of package cost (%)	Share of VA (%)	Share of package cost (%)	Share of VA (%)	Share of package cost (%)
Monetary obligations	0.03	16.03	0.05	16.23	0.03	11.06
CAPEX	0.05	30.87	0.01	20.39	0.04	12.77
OPEX	0.06	34.42	0.01	34.87	0.17	57.51
Admin burden	0.03	18.67	0.02	28.51	0.05	18.66
Total	**0.17**	**100.00**	**0.05**	**100.00**	**0.29**	**100.00**

Source: Authors' elaboration

Customs and trade package is the least important representing only 0.05% of the value added. Of the two directives included in the package, the Prior Informed Consent Regulation is the main driver of cost. Changes in the classification of substances generate additional cost due to changes in the requirements for packaging and labelling under the CLP.

5.1.7 Cumulative cost of legislation by size of companies

Company size seems to effect the impact of legislation on cost, as cost's share in value added is higher for SMEs for all packages, except 'customs and trade', reflecting the existence of economies of scale. However, further investigation, which exceeds the scope of this study, is necessary to understand better the reasons for the significant differences between the two groups.

Figure 25: Legislation cost by size of firms — annual share of turnover 2004–2014 — specialty chemicals are excluded

Note: Data available for the specialty chemicals were not sufficient for estimation

Source: Authors' elaboration

5.1.8 Evolution of cumulative cost

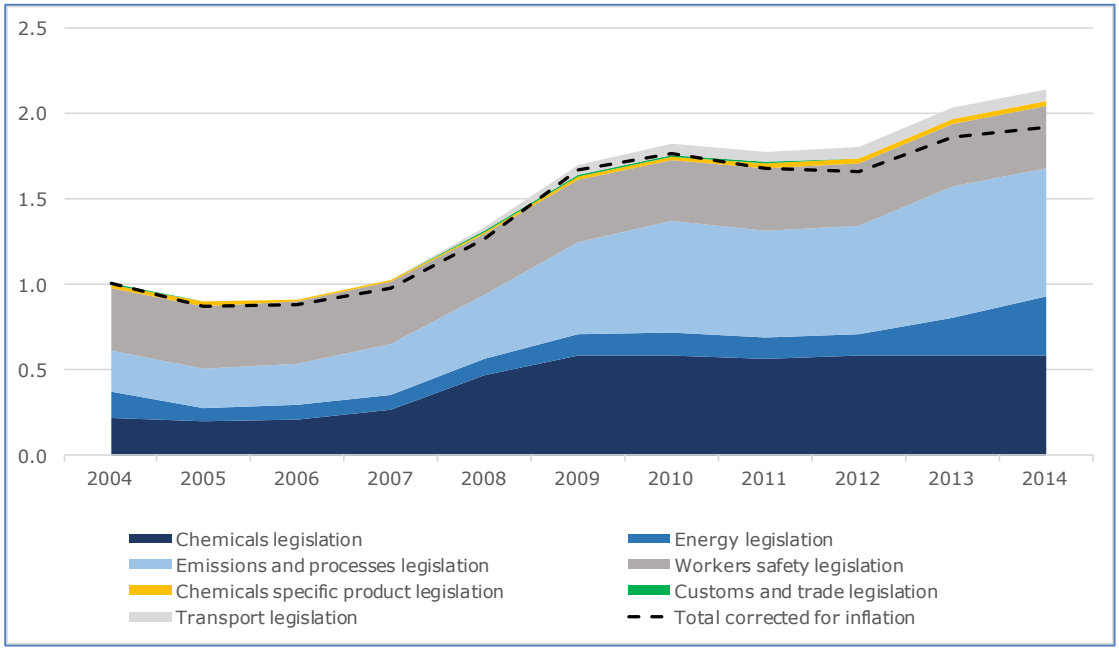
Figure 26 presents a visualisation of the evolution of costs over time (period 2004-2014) based on data from the panel of companies. The figure should be interpreted with caution, as this is an estimate of the trend based on a subset of companies and their recollections of past costs. Cost figures were not calibrated with data from the online survey. Furthermore, investment costs were annualised using straight-line depreciation. Hence, it provides an idea of how costs have evolved over time for the different legislation packages and should be interpreted only for identifying years or periods over which larger costs are observed. Even more, as has been explained in the methodology chapter, information about the most recent years is more accurate than about the earliest years of the examined period.

Cost per turnover is presented as a cost index, with the reference value in 2004 set at 1. The average thickness of a layer is proportional to the share of the corresponding package in the total costs for all sectors. As the denominator uses the average turnover of the last three years, the trend is not corrected for inflation. The dotted line in the graph presents the total figure adjusted for inflation.

The method of the estimation of the index is presented in Annex 1.

Overall, Figure 26 suggests an increase of regulatory costs for the chemical sector over 2004-2014. This trend is mostly driven by chemicals and industrial emissions legislation and to a lesser extent by energy legislation at the end of the period.

Figure 26: Evolution of cost over the period 2004–2014 — Index 2004=1



Source: Authors' elaboration

The cost associated with chemicals legislation increased strongly between 2007 and 2010. The increase corresponds to the initial phases of implementation of REACH (as of January 2007) and of CLP (as of 2008). Cost seems stable between 2009 and 2014. This trend could reflect a shift of cost from companies producing high-volume chemicals (over 1,000 tonnes per year) to companies producing chemicals in the range of 100 to 1,000 tonnes, corresponding to the registration deadline of 2013. Costs associated with the implementation of measures related to the Regulations on Plant Protection Products and on Biocide Products, in 2009 and 2012 respectively, explain the observed trend. The REACH-related cost is expected to decrease after 2018, the final deadline for registering existing substances placed on the market. Similarly, a significant reduction in the costs related to CLP can be expected after the final deadline in 2017.

The cost related to energy legislation is stable over time, although it increased slightly after 2012. The cost increase could reflect the implementation of anticipatory measures associated with the entry into force in 2014 of the Energy Efficiency Directive. However, this hypothesis

should be verified following an in-depth analysis of the drivers based on a dedicated survey.

The costs associated with legislation addressing emissions seem to have increased after 2006 and remain stable during the period 2010-2014[37]. In comparison, Eurostat data present the turning point three years later in 2009, increasing the cost from slightly above 2% of value added in 2008 to approximately 3% after 2010.

Two incremental steps in 2009 and 2010 could reflect investments of companies in anticipation of the enforcement of Seveso III in 2012 and ETS (phase III) in 2013. The cost associated with the implementation of new Best Available Techniques under the revised Industrial Emission Directive might also explain part of the pattern. On the one hand, the purchase of CO_2 allowances will increase over the years due to the reduction of free allowances while, on the other hand, the CO_2-emission limits reduce over time. Both trends will increase the demand for allowances and will therefore push their price up.

The cost related to workers' safety legislation appears to be stable over the period as no new legislation came into force.

A slight increase in cost related to product-specific legislation and transport legislation is observed after 2008.

5.2 Cumulative cost assessment by cost category

Among the cost categories, capital expenditures (CAPEX) and operating cost (OPEX) predominate, representing approximately 39% and 32% of the cost respectively. Monetary obligations follow with approximately 20% of the cost, while administrative burden represents 10% of the cost. As shown in Table 25, Figure 27 and their importance varies across the various sectors and legislation packages.

Monetary obligations are the most important source of cost in the energy package (taxes and levies) while they are second in the chemicals package, where REACH and CLP registration fees account for the majority of the cost. CAPEX is the most important for the industrial emissions and chemical packages.

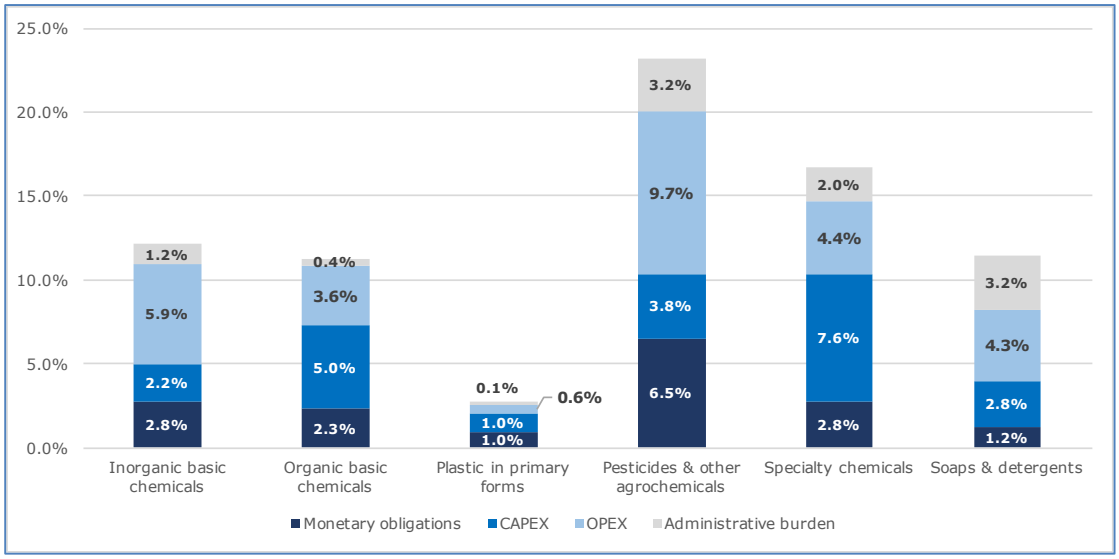
[37] The observed shift upwards after 2012 is the effect of the increase of energy-related cost. When the effects of the other layers are removed, the cost remains stable for the whole period 2010-2014.

Table 25: Categories of cumulative cost of legislation by subsector—average values per year in € billion

	Share of value added							
Cost categories	Inorganic basic chemicals	Organic basic chemicals	Plastics in primary forms	Pesticides and agrochemicals	Specialty chemicals	Soaps and detergents	Total	**Total in € billion**
Monetary obligations	2.8	2.3	1.0	6.5	2.8	1.2	2.4	1.9
CAPEX	2.2	5.0	1.0	3.8	7.6	2.8	4.6	3.7
OPEX	5.9	3.6	0.6	9.7	4.4	4.3	3.8	3.0
Administrative burden	1.2	0.4	0.1	3.2	2.0	3.2	1.2	1.0
Total	**12.1**	**11.3**	**2.7**	**23.2**	**16.7**	**11.4**	**12.0**	**9.5**

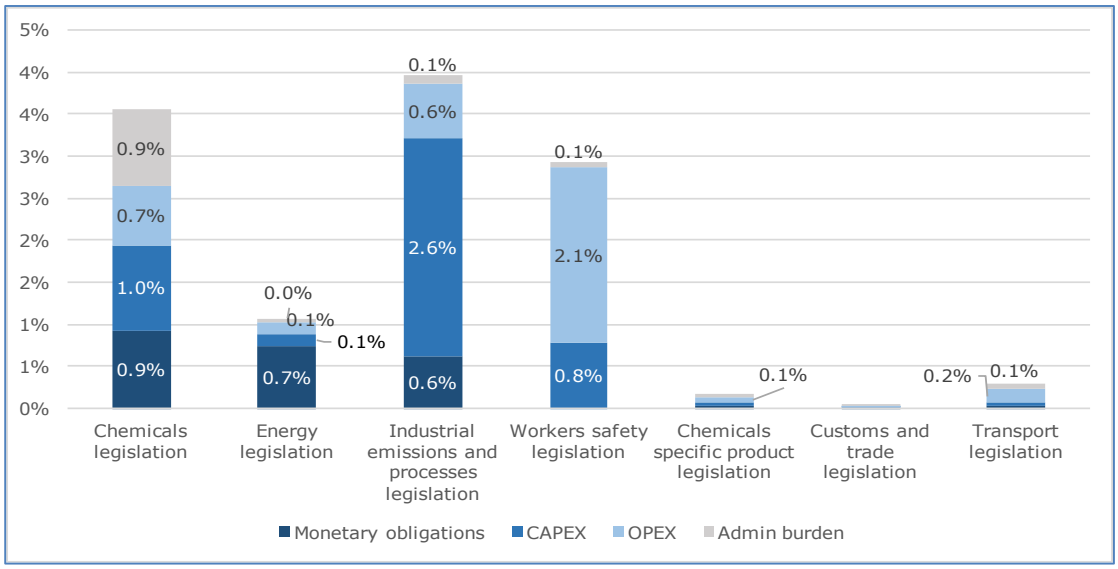
Source: Authors' elaboration

Figure 27: Cumulative cost per subsector and its composition by cost category — share of value added, annual average 2004–2014



Source: Authors' elaboration

Figure 28: Type of cost by legislation package —share of value added, annual average 2004–2014



Source: Authors' elaboration

In the following sections, the structure of legislation-related cost for each subsector and its relation to specific packages and cost categories is discussed in detail.

5.3 Cumulative cost of EU regulation in the selected subsectors

Pesticides and other agrochemicals bear the highest cost among the six subsectors, amounting to 23% of their value added, followed by specialty chemicals with 16.6%. The sector with the lowest impact is plastics with cost not exceeding 3%.

5.3.1 Cumulative Cost for inorganic basic chemicals

Eurostat definition of NACE code 20.13 – Inorganic basic chemicals

The manufacture of inorganic basic chemicals includes the manufacture of chemicals using basic processes. The outputs of these processes are usually separate chemical elements or separate chemically defined compounds. More specifically, it includes the manufacture of chemical elements (except industrial gases and basic metals), the manufacture of inorganic acids except nitric acid, the manufacture of alkalis, lyes and other inorganic bases except ammonia, the manufacture of other inorganic compounds, the roasting of iron pyrites, the manufacture of distilled water. It also includes the enrichment of uranium and thorium ores (Eurostat, 2015).

Basic chemicals are produced in vast quantities (62% of European sales)[38] and form essential building blocks that are used worldwide as intermediates or as feedstock for the production of most synthetic materials used in modern society. Inorganic basic chemicals are simple, yet cover a very wide range of chemical compounds — excluding most carbon-based compounds, which imply the bonds of carbon and hydrogen, and are known as "organic". Inorganic basic chemicals include metals, minerals and organometallic compounds.

The main products are chlorine, sulphuric and phosphoric acids, ammonia, and titanium dioxide. Ammonia is mostly used in the production of fertilisers (80%) and the balance (20%) for the production of nylons, fibres, plastics, coatings, adhesives and explosives. Chlorine is a major component in the manufacture of polyvinyl chloride (which is used in pipes, textiles or furniture), agrochemicals and pharmaceuticals. Water treatment and sterilisation operations also involve chlorine. Titanium dioxide can be further used in paints, coatings, plastics, paper, inks, fibres, food, cosmetics and photocatalysts.

Due to the characteristics of its production chains, all legislation packages are relevant for the sector, generating an annual cost amounting approximately to €860 million that represents 12% of the sector's value added. Compared to the gross operating surplus (GOS), which is a proxy for profit, the cost for the sector reaches 32%.

Important products such as chlorine and sulphuric and phosphoric acids are hazardous and, at some stages of the production, storage and transport involve significant risk for health and safety. Therefore, the sector is subject to the industrial emissions and processes legislation, which generates 54% of all legislation cost, representing approximately 7% of the sector's value added. Most relevant costs related to industrial emissions and processes are those related to compliance with the Industrial Emissions Directive (compliance with Best Available Techniques), ETS Directive, Seveso Directives and the Water Framework Directive. Chlorine production is very energy intensive and consumes up to 3MWh/tonne of electricity, which often is produced on site with dedicated boilers and power plants supplying electricity to chlorine production units. CO_2 emissions, hence ETS costs are associated with electricity production.

[38] CEFIC (2011), American Chemistry Council (2011)

Table 26: Costs by package and comparison with main financial indicators — shares, annual average 2004–2014

Inorganic basic chemicals	% VA	%GOS	% turnover
Chemicals legislation	1.7	4.5	0.4
Energy legislation	2.0	5.4	0.5
Emissions and processes legislation	6.6	17.1	1.5
Workers safety and health legislation	1.5	4.0	0.3
Product specific legislation	0.1	0.2	0.0
Customs and trade legislation	0.1	0.1	0.0
Transport legislation	0.2	0.5	0.0
Total	**12.1**	**31.8**	**2.7**

Source: Authors' elaboration

The production of chlorine, which in terms of volume is the most important product, is energy intensive due to the involvement of electrolysis in the production process. Although the use of membrane technology has reduced electricity consumption by 30%, 2500 KWh of electricity is still required to produce one tonne of chlorine (Rizos et al, 2014). The high energy consumption is reflected in the cost of energy legislation, which is the second highest (17% of the total legislation cost), amounting to 2% of the value added per year. The main component is the monetary obligations resulting from energy taxation and renewable energy surcharges.

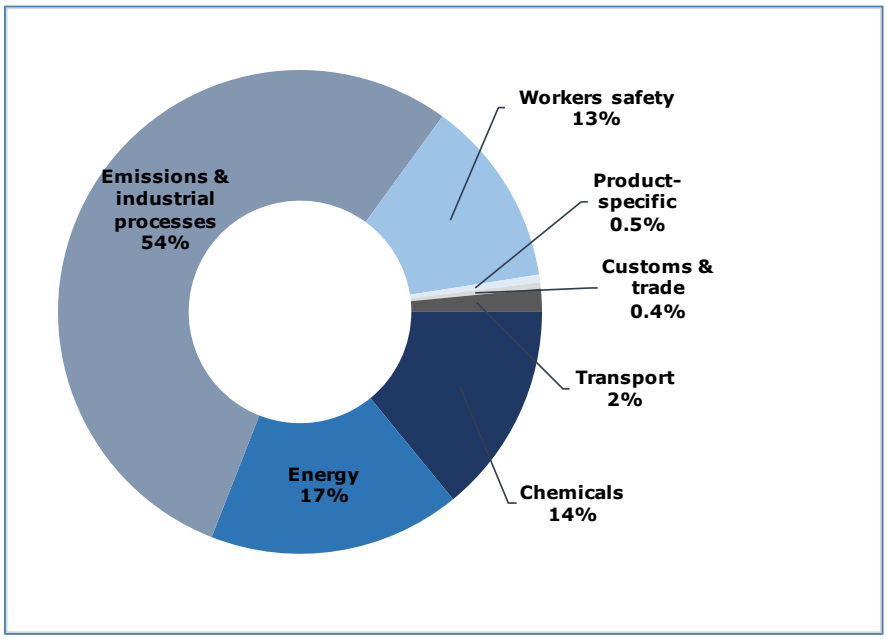
Chemical legislation represents 14% of the total costs of legislation (2% of the value added). The large share of costs is attributable to Reach, CLP and the Biocide Regulation. The main cost results from the registration fees under the Biocide regulation (monetary obligations) and from the preparation of registration dossiers (data collection, testing and exposure scenarios) to include chlorine in the list of active biocide substances (operating expenses).

Workers and safety regulation is the fourth most important package, representing 13% of the total cost. Key costs result from substantive obligations to implement workers' protection measures.

All other packages have only a marginal impact on cost as altogether they represent approximately 3% of the total cost. Drivers in Customs and Trade legislation are related to PIC regulation. Specific CAPEX and OPEX costs are incurred for the special containment required under Transport legislation.

Operating expenses related to changes in production techniques, control systems and emissions abatement equipment, waste water treatment or alternative process equipment are the main cost driver in OPEX for the subsector representing 49% of total cost. For the energy package in particular, operating expenses can be explained by the cumulative costs of maintenance and operations resulting from new and more efficient steam boilers, membrane plants replacing mercury plants and co-generation units.

Figure 29: Inorganic basic chemicals: Significance of legislation packages –share of cost in total subsector cost, annual average 2004-2014

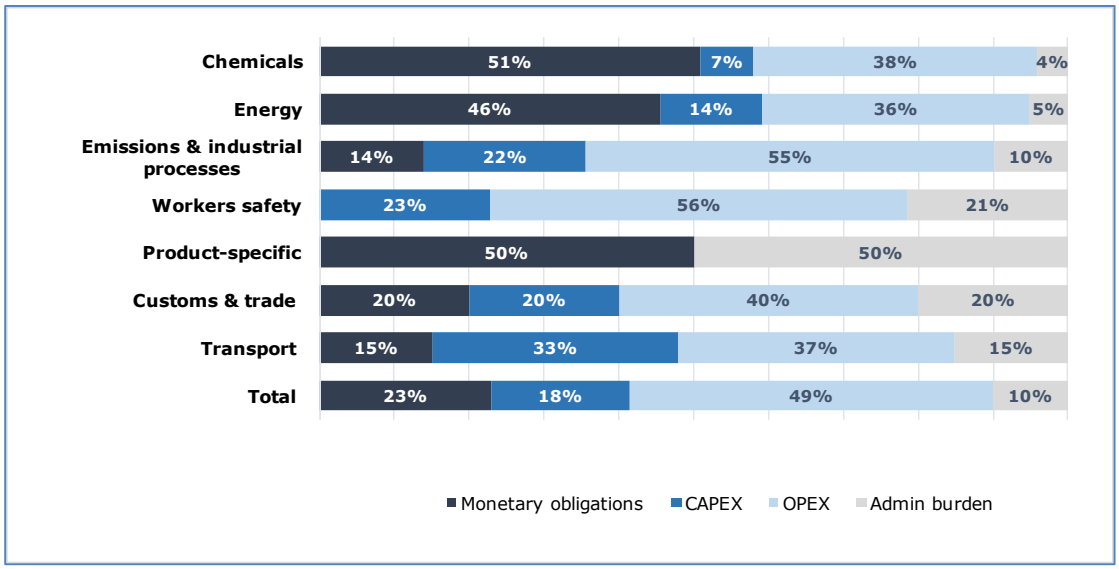


Source: Authors' elaboration

The second most important category of cost is monetary obligations due to REACH and biocide fees, energy taxes and ETS.

Perspective on costs for the period 2014-2020 can be mainly associated with the full implementation of the Best Available Technique, meaning the replacement by membrane technology of the remaining 25% chlorine-production capacity that still uses mercury technology.

Figure 30: Inorganic basic chemicals: Significance of cost categories per legislation package – share of package cost, annual average 2004-2014



Source: Authors' elaboration

Cumulative cost for organic basic chemicals

Eurostat definition of NACE code 20.14 – Organic basic chemicals

Organic basic chemicals include the manufacture of chemicals using basic processes, such as thermal cracking and distillation. The outputs of these processes are usually separate chemical elements or separate chemically defined compounds. This class includes the manufacture of basic organic chemicals, acyclic hydrocarbons, saturated and unsaturated, cyclic hydrocarbons, saturated and unsaturated, acyclic and cyclic alcohols, mono- and polycarboxylic acids, including acetic acid, other oxygen-function compounds, including aldehydes, ketones, quinones and dual or poly oxygen-function compounds, synthetic glycerol, nitrogen-function organic compounds, including amines, fermentation of sugarcane, corn or similar to produce alcohol and esters, other organic compounds, including wood distillation products (e.g. charcoal) etc., manufacture of synthetic aromatic products and distillation of coal tar. (Eurostat, 2015).

Organic basic chemicals include structurally diverse chemical compounds whose molecules contain carbon and hydrogen, and often functional groups containing oxygen, nitrogen or sulphur. Key organic basic chemicals are ethylene, propylene, methanol, benzene and methylbenzene, phenol, styrene. They are the key building blocks (raw material) in the manufacturing of most chemicals used to make consumer products (textile fibres, solvents, detergents, paints, cleaning agents, adhesives, biocides, air fresheners, dyes, plastics, electronics, etc.), pharmaceuticals, petrochemicals and all products based on them, plastics, fuels, explosives, etc.

Ethylene represents the largest volume of this category of chemical, with 19 million tonnes produced in 2012, and is a key building block for making plastics, anti-freeze products and solvents. Propylene forms the basis of a large number of chemicals (e.g. addition polymer), with 14.3 million tonnes of production in 2012 in Europe. Methanol, with 2.6 million tonnes produced in 2012 in Europe, is used in the manufacture of resins and polymers and as a disinfectant, conservation agent in vaccines, etc. Benzene and methylbenzene, with 7.2 million tonnes of production in 2013 in Europe for benzene, are the main components of aromatics (Petrochemicals Europe, 2014 and University of York, 2014).

Steam or catalytic cracking of gas and oil produces ethylene and propylene. Over 50 steam crackers operate across the European Union and transform petroleum liquids and natural gas liquids into high-value materials, which will further be used by other downstream and manufacturing industries.

Products are considered as commodity products (customer decision is mostly based on price) and are very dependent on feedstock and energy availabilities and prices. Manufacturing of organic basic chemicals is energy intensive and requires large amounts of heat, pressure and cooling. 80% of petrochemical cash costs are related to the oil and gas used as feedstock and energy (Petrochemicals Europe, 2014). Overall, the subsector is dominated by large enterprises.

The overall legislation cost amounts to approximately €3 billion corresponding to 11% of the subsector's value added.

Industrial emissions and processes legislation package generates almost 48% of the legislation cost, which corresponds approximately to 5% of the value added. Directives dealing with "Emissions Trading System", "Industrial emission", "Emission limit values in air and water" and Seveso require large investments to comply with environmental emission limits and safety requirements. Most costs relate to investments (CAPEX) and operating cost (OPEX) of capital-intensive equipment. ETS generate significant monetary obligations for the purchase of CO_2 emission allowances.

Indeed, although the European chemical sites manufacturing basic organic chemicals receives free allowances for their CO_2 emissions at the benchmark value, the amount of free allowances covers only a small part of CO2 emissions. The benchmark value is set for specific industrial processes such as olefins production using steam cracking, aromatics extraction, and is calculated as the average of the top 10% best performing plants. Facilities emitting greenhouse gases must purchase their annual emissions allowances above the benchmark value.

As explained under chapter 4, a number of industries falling under the scope of ETS received allowances in excess of their real emissions and banked these to cover further expansion of their production capacity or to generate profits from trading. However, chemical installations were not listed in the annexes of ETS I and ETS II and were therefore excluded from the scope of ETS until the adoption of ETS III. There was thus no

banking of allowances due to chemicals production before the adoption of ETS III.

Table 27: Costs by package and comparison with main financial indicators — shares, annual average 2004–2014

Organic basic chemicals	%VA	%GOS	% turnover
Chemicals legislation	1.1	2.6	0.2
Energy legislation	0.9	1.9	0.2
Emissions and processes legislation	5.4	12.2	1.0
Workers safety and health legislation	3.4	7.8	0.6
Product specific legislation	0.2	0.4	0.0
Customs and trade legislation	0.1	0.2	0.0
Transport legislation	0.2	0.5	0.0
Total	**11.3**	**25.6**	**2.0**

Source: Authors' elaboration

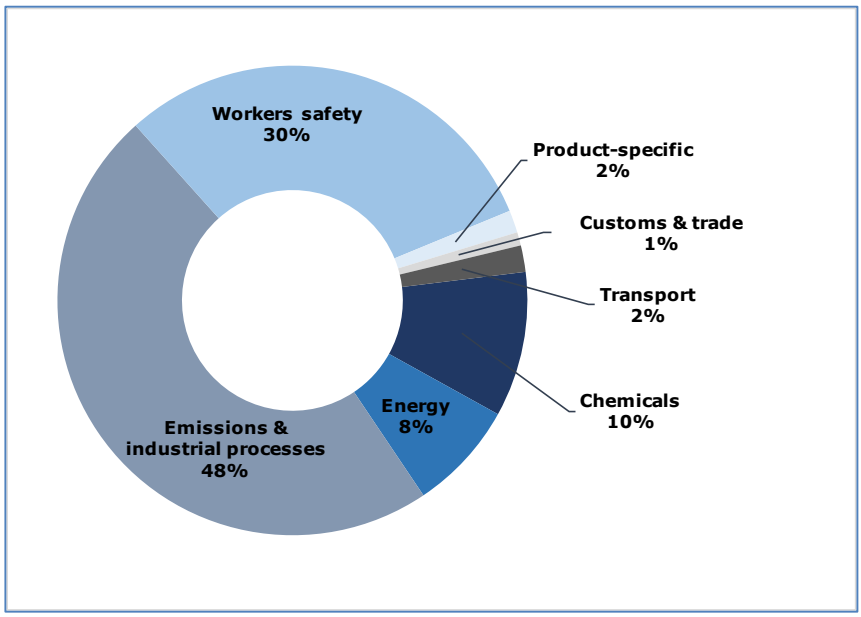
Workers safety and health legislation is responsible for the second largest share (30%) of cumulative costs. Gaseous Organic Basic chemicals are hazardous and explosive and their production, storage and handling require very strict safety equipment and measures, leading to capital expenditures and operating expenses, continuous training and monitoring equipment.

Cost of chemical legislation mostly results from REACH and CLP implementation with a large share of cost due to registration fees (monetary obligations — 44%) and the preparation of dossiers (administrative burden — 14%). CAPEX and OPEX charges result from investments in IT systems, testing and labelling equipment and their maintenance, and recurrent upgrades and training.

Although manufacturing is energy intensive, energy legislation has a moderate impact on costs, representing around 8% of the legislation cost, equivalent to 1% of the value added. Most of the energy needed results from the combustion of the fuels used as feedstock. Heat and steam produced within the perimeter of installations is converted to pressure power and electricity. However, requirements for energy efficiency and cogeneration can generate significant substantive obligations, in the form of CAPEX and OPEX due to investments and operating costs of cogeneration units or efficient boilers.

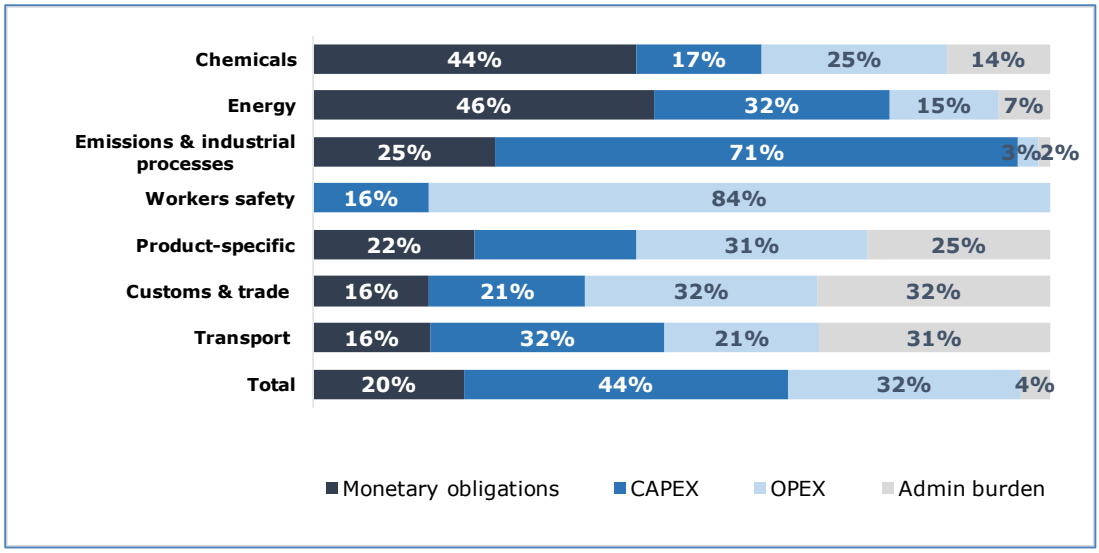
CAPEX associated with the emissions and industrial processes package are particularly large, due to investments in CO_2 emission reduction systems, such as new burners, and energy efficient units such as boilers, compressors, cooling units, all capital intensive. On the other hand, the cumulative OPEX is very low. One explanation is that CAPEX investments were made at the end of the 10-year period and have not generated significant operating expenses yet.

Figure 31: Organic basic chemicals: Significance of legislation packages — share of cost in total subsector cost, annual average 2004-2014



Source: Authors' elaboration

Figure 32: Organic basic chemicals: Significance of cost categories per legislation package — share of package cost, annual average 2004–2014



Source: Authors' elaboration

Companies operating in the subsector reported growing costs associated with energy audits since the adoption of the Energy Efficiency Directive in 2012. Monetary obligations include taxes and levies resulting from the implementation of Energy Taxation and Renewable Energy Directives.

Regulation on plastics in contact with food, and legislation limiting the use of solvents in paints, generate costs of substitution and reformulation for the manufacturers of organic basic chemicals, in order to provide alternative solutions to their clients.

Within the legislation package on Customs and trade, PIC regulation (Prior Information Consent) and Drug Precursor generate administrative burden and some monetary obligations.

Transport legislation generates costs in CAPEX and OPEX categories due to investments in chemical transport vessels, safety measures and labelling (ADR).

It is expected that costs associated with chemical legislation will decrease since most large-volume organic basic chemicals were due for registration respectively in 2010 and 2013.

Costs associated to industrial emissions and energy are expected to continue to grow as a function of stricter emission and energy efficiency targets.

5.3.2 Cumulative cost for plastics in primary forms

Eurostat definition of NACE code 20.16 – Plastics in primary forms

The manufacture of plastics includes the manufacture of resins, plastics materials and non-vulcanisable thermoplastic elastomers, the mixing and blending of resins on a custom basis, as well as the manufacture of non-customised synthetic resins, and the manufacture of cellulose and its chemical derivatives. The manufacture of plastics in primary forms encompasses polymers, including those of ethylene, propylene, styrene, vinyl chloride, vinyl acetate and acrylics, polyamides, phenolic and epoxide resins and polyurethanes, alkyd and polyester resins and polyethers, silicones, ion-exchangers based on polymers (Eurostat, 2015).

The main products in the subsector are polyethylene (29.6% of EU demand, when accounting for low and high density polyethylene)[39], polypropylene (18.9% of EU demand), polyvinyl chloride (10.4% of EU demand) followed by polystyrene. Polyethylene, produced with different levels of density, is the most important plastic: its main uses include

[39] York University (2014) and PlasticsEurope (2015)

packaging (film) and containers (bottles and buckets). It is used for both household chemicals and industrial packaging. Polypropylene has particular properties, such as lightness, heat resistance, good transparency, stretchability and recyclability, which makes it an appropriate replacement for glass and metallic components, cartons or simply other polymers. The main uses of polypropylene are packaging films, textile fibres for clothing, car bumpers and certain bowls or flower containers. Polyvinyl chloride, most commonly called "PVC" is the most versatile plastic, widely used. Its properties allow the production of plastics with different characteristics from rigid to pliable. Its main applications are in building and construction, e.g. in making doors and windows outlines or pipes, but it is also used for packaging in food films and bottles, and for cable insulation, e.g. in electronic devices.

Legislation cost for plastics is the lowest among the investigated subsectors, amounting to around €350 million corresponding to 3% of the subsectors' value added. This lower amount reflects the position of the polymer manufacturers in the product chain of plastics. Most expenditure associated with legislation take place upstream at the manufacture of basic chemicals.

Table 28: Costs by package and comparison with main financial indicators –shares, annual average 2004-2014

Plastics in primary forms	%VA	%GOS	% turnover
Chemicals legislation	0.5	1.3	0.1
Energy legislation	0.8	2.2	0.1
Emissions and processes legislation	1.1	3.1	0.2
Workers safety and health legislation	0.0	0.0	0.0
Product specific legislation	0.3	0.8	0.0
Customs and trade legislation	0.0	0.0	0.0
Transport legislation	0.0	0.0	0.0
Total	**2.7**	**7.4**	**0.4**

Source: Authors' elaboration

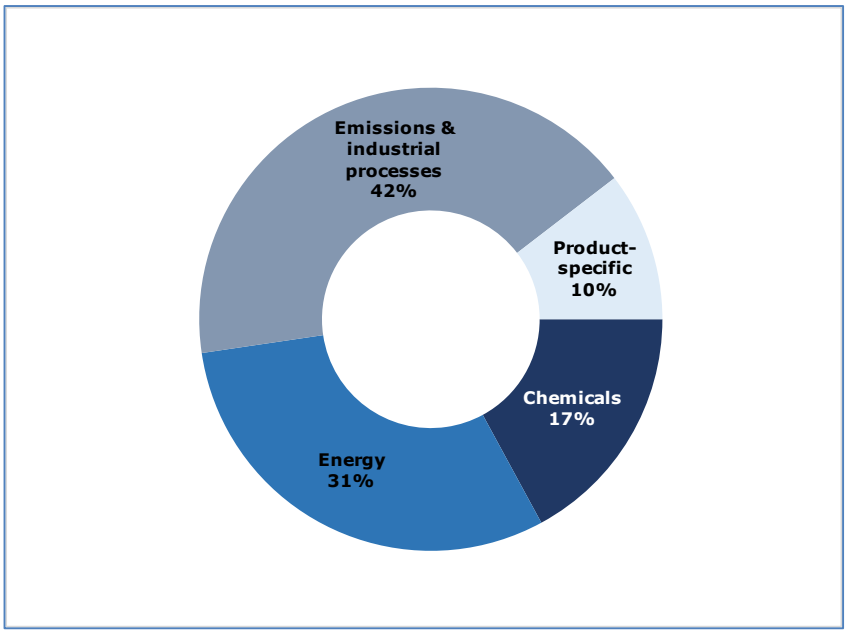
The costs of compliance with chemicals legislation are mainly caused by CLP legislation and by REACH, which imposes registration for plastic additives and components. As such, polymers are exempted from REACH registration, however, the development of exposure scenarios, risk analysis and search for alternatives to substances placed on the candidate list for authorisation required dossier preparation, monitoring of legislation, information through the supply chain, search for alternative substances, socio-economic analysis and R&D for reformulation. Costs incurred under this package of legislation concern operating expenses, administrative burden, training of staff, participation in a consortium, hiring of external consultants, and testing and search for alternative substances. Polymer manufacturers must in addition ensure that all components used in the manufacturing of polymers and imported articles

are registered. Monetary obligations result from REACH obligations and registration of chemical components associated with polymers.

Plastics in primary forms are obtained by polymerisation, a process that requires moderate energy compared to basic chemicals. However, steam power and electricity are needed and direct compliance costs can arise from legislation applicable to power production equipment installed on polymer production sites, while indirect costs are passed on from energy producers located outside the perimeter.

Cost under the energy package concerns energy efficiency, energy taxation, renewable energy and cogeneration units. Many polymer plants are integrated to basic chemical's production plants and share part of their compliance obligations. Stand-alone polymer units need their own sources of heat and steam and consume large amount of electricity. Costs associated with energy efficiency incur directly when sites manufacturing polymers are equipped with power units. Monetary obligations result from taxes and levies applied on energy consumption and are associated with Energy Taxation and Renewable Energy Directives. Monetary obligations represent 78% of the costs associated with energy legislation, however the overall amount is relatively small and it is less than 1% of the subsector's value added.

Figure 33: Plastics in primary forms: Significance of legislation packages – annual share of cost in total subsector cost, annual average 2004-2014



Source: Authors' elaboration

Industrial emissions and processes legislation generates the same type of compliance costs as basic chemicals but to a lower extent due to the low level of hazard associated with plastic manufacturing. ETS includes

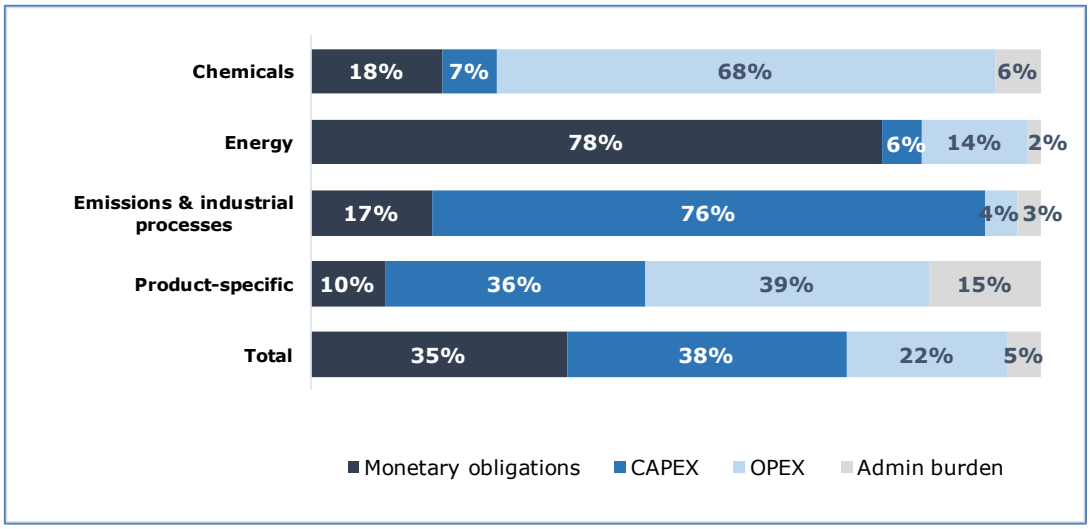
polymer manufacturing, hence direct costs associated with monetary obligations to purchase CO_2 emissions allowances. Recognised as a sector exposed to carbon leakage, polymers benefit from CO_2 allowances at the level of the benchmarks set for steam boilers generating heat and electricity. Monetary obligations associated with ETS are low compared to energy intensive sectors manufacturing basic chemicals. Polymer manufacturing was not part of the sectors covered under ETS I and ETS II. There was therefore no banking of CO_2 allowances.

Legislation regulating waste, such as the Landfill of Waste, Packaging Waste and End-of-Life Vehicle Directives, require efforts from the plastics subsector and generate information obligations, recycling campaigns, search for alternative substances and administrative burden.

Plastics are not hazardous products and this is reflected in the cost of almost all legislation packages. Therefore, it is expected that legislation on customs and trade, transport legislation and workers' safety legislation do not generate measurable costs for the subsector beyond business as usual.

Chemical specific legislation costs include compliance costs related to the regulation on Plastic materials and articles intended for contact with food (Regulation EU 10/2011 and 202/2014), RoHS, Toy Safety Directive and the Construction Products Regulation. Most costs are linked to information obligations, the preparation of dossiers and testing.

Figure 34: Plastics in primary forms: Significance of cost categories per legislation package — annual share of package cost, annual average 2004–2014



Source: Authors' elaboration

Due to the diversity of the applications, several of the products are affected by product-specific legislation, and thus the significance of this

package is higher compared to other subsectors, although overall this represents only 10.4% of the legislation cost for the subsector.

Trends in future costs of chemicals legislation depend on the possible inclusion of polymers under REACH and reformulation if specific plastics components are subject to authorisation.

Costs associated to energy legislation are expected to follow the same trends as with other subsectors depending on significant energy needs, i.e. a gradual increase as a function of energy efficiency targets and the renewable energy component. Costs associated with energy audits will increase with a pattern similar to other subsectors.

5.3.3 Cumulative cost for pesticides and other agrochemicals

Eurostat definition of NACE code 20.20 – Pesticides and other agrochemical products

The manufacture of pesticides and other agrochemical products includes the manufacture of insecticides, rodenticides, fungicides, herbicides, acaricides, molluscicides, biocides; the manufacture of anti-sprouting products, plant growth regulators; the manufacture of disinfectants (for agricultural and other use) and the manufacture of other agrochemical products not elsewhere classified (Eurostat, 2015).

Pesticides belong to the class of biocides, a family of chemical products that also includes disinfectants. Pesticides are widely used as plant protection products (also called crop protection products) to control harmful organisms like weeds, diseases or insects, mainly for agricultural purposes.

Despite their benefits (e.g. improving or preserving the quality of agricultural products, limiting soil erosion and guaranteeing an appropriate supply of products), pesticides may cause hazards to non-target organisms, affecting both human health and the environment. Impacts on health can be from direct exposure (by industrial workers and farmers) or indirect exposure (consumers or individuals residing close to fields). With respect to the environment, the misuse of pesticide can lead to contamination of water, air and soil and can harm biodiversity.[40]

For all these reasons, pesticides and other agrochemicals are strictly regulated and in relative terms bear the highest legislation cost among the subsectors, reaching 23% of the subsector's value added and 55% of

[40] European Commission (2007).

gross operating surplus. In absolute terms the cost is the third highest amounting to approximately €700 million.

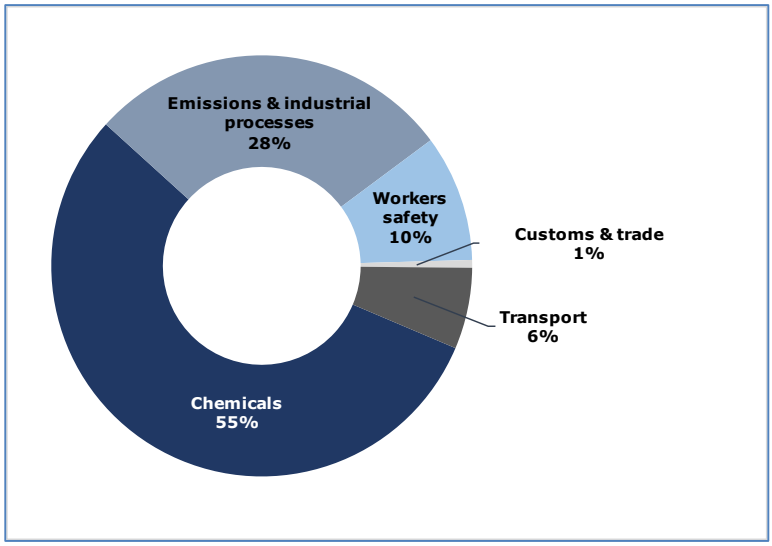
Table 29: Costs by package and comparison with main financial indicators — shares, annual average 2004–2014

Pesticides & other agrochemicals	%VA	%GOS	% turnover
Chemicals legislation	12.8	30.4	2.6
Energy legislation	0.00	0.0	0.0
Emissions and processes legislation	6.5	15.4	1.3
Workers safety and health legislation	2.3	5.3	0.4
Product specific legislation	0.0	0.0	0.0
Customs and trade legislation	0.1	0.3	0.0
Transport legislation	1.4	3.4	0.3
Total	**23.1**	**54.8**	**4.6**

Source: Authors' elaboration

Chemicals legislation is the source of the highest cost, representing 55% of the total legislation costs and equivalent to 13% of the subsector value added, the highest among all subsectors. The main sources of cost in this package are pieces of legislation addressing the 'Risks and Hazards of Plant Protection Products and Biocides', and in particular the Regulation (EC) No 1107/2009 and its predecessor the Council Directive 91/414/EEC concerning the placing of plant protection products on the market. Legislation addressing industrial emissions and workers' safety account for 28% and 10% of costs respectively.

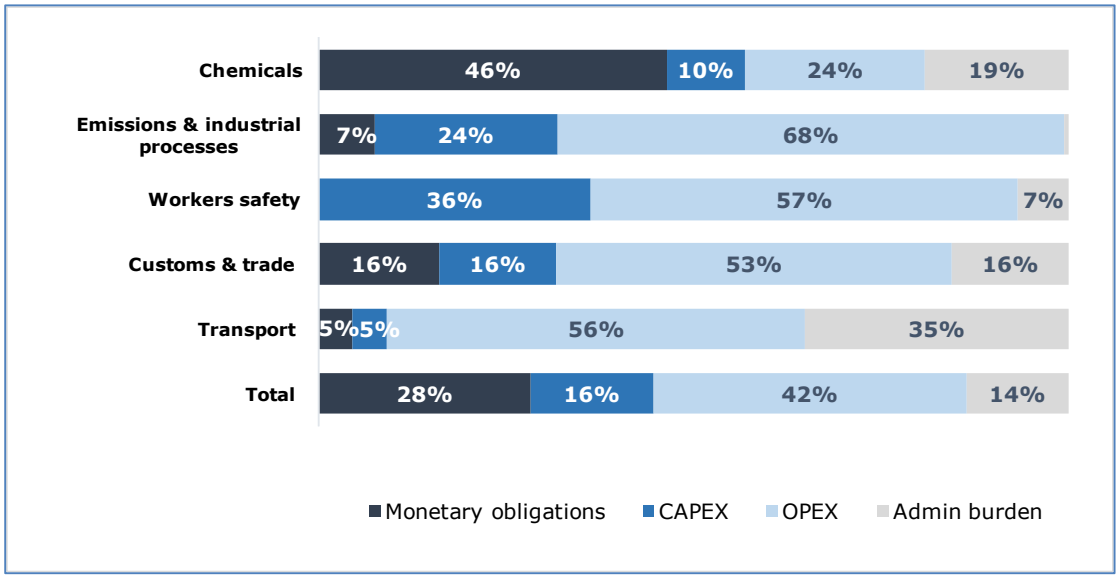
Figure 35: Pesticides & other agrochemicals: Significance of legislation packages – share of cost in total subsector cost, annual average 2004-2014



Source: Authors' elaboration

46% of the costs associated with the chemicals package results from monetary obligations related to the authorisation process, comprising fees paid to Member States to evaluate active substances at Union level and fees paid to Member States to authorise the placement of plant protection products on the national market. Due to the complexity of validation and authorisation procedures, fees to register active substances and active products are high, variable from region to region and cumulative. The level of the fee differs significantly between Member States.

Figure 36: Pesticides & other agrochemicals: Significance of cost categories per legislation package – share of package cost, annual average 2004-2014



Source: Authors' elaboration

19% of the package's cost consists of costs related to administrative burden for the preparation of the authorisation dossier and the regular update of information for the competent authorities. The staff in charge of such dossiers' preparation is highly qualified and the amount of work is higher than for other EU regulations due to the different national authorisation systems.

The Directive on sustainable use of pesticides generates significant information obligations to pesticides users, agrochemicals distributors and farmers.

The costs related to industrial emissions and process legislation are high and represent 28% of cumulative costs and 6.5% of the value added of the subsector. The main component of the cost is the operating cost for the operation and maintenance of wastewater treatment systems and other equipment preventing emissions to air, soil and ground. Sites producing plant protection products are all classified Seveso and require particular prevention measures such as containment systems, double hull, and emission controls systems.

Workers' safety legislation is the third most important package, representing almost 10% of the legislation cost and 2.3% of the subsector's value added. Pesticides are hazardous and toxic via direct and indirect exposure; some of them are carcinogenic. Therefore, a high level of protection in the working environment is necessary. Severe protective measures generate higher compliance cost.

Most of the costs incurred from this package are in categories CAPEX and OPEX and result from the necessary investments in individual and collective protection equipment, including monitoring, personnel training and emission abatements systems in production installations and the relevant operating cost.

For similar reasons, the cost of compliance with transport legislation is almost seven times higher compared to other packages and represents approximately 6% of total cost and 1 % of value added. Operating costs exceed 55% due to Agreement on transport of dangerous goods (ADR), packaging and transport procedures. Administrative burden covers information obligations to authorities and the community at large.

Costs associated with Customs and trade legislation, although moderate in size, are the highest of all subsectors, and generated by implementation measures to comply with the PIC Regulation (Prior Information Consent). PIC manages authorisation procedures to export and import dangerous chemicals from and to the European territory.

In the near future, industry expects cost increases due to national authorisation schemes and fees paid to Member States to authorise the placement of plant protection products on the national market. An efficient implementation of the principle of mutual recognition is expected to reduce costs.

5.3.4 Cumulative cost for specialty chemicals

Definition of other specialty chemicals

Specialty chemicals is a heterogeneous group, defined for the needs of the study. It includes NACE 20.30 "paints, varnishes and similar coatings, printing ink and mastics" and selected specialty chemicals products such as silicones, fibres, resins, essential oils and fragrances which are usually classified under NACE 20:59

Eurostat definition of the subsector 20.30: The manufacture of other specialty chemicals includes the manufacture of paints, varnishes and similar coatings, printing ink and mastics (paints and varnishes, enamels or lacquers; prepared pigments and dyes, opacifiers and colours; vitrifiable enamels and glazes and engobes and similar preparations; mastics; caulking compounds and similar non-refractory filling or surfacing preparations; manufacture of organic composite solvents and thinners; prepared paint or varnish removers; printing ink) (Eurostat, 2015).

Specialty chemicals are chemical substances that are marketed on the basis of their performance or functionality, and not for their composition, unlike commodity chemicals, which are interchangeable products sold based on their composition. As a matter of fact, they substantially impact the performance of final products; therefore, they are highly knowledge- and innovation-intensive. The main specialty chemicals are specialty polymers, construction chemicals, flavour and fragrance, specialty coatings, printing inks, etc. (IHS, 2015). They are produced in relatively small quantities compared to commodities but they represented, on average, 26% of chemical sales from 2004 to 2013.

Due to the heterogeneity of products, hence heterogeneous health, environmental and safety requirements, it is not possible to draw conclusions regarding the drivers of costs of legislation that are valid for each specific group of products included in the subsector. However, the companies surveyed among the specialty products, paints, coating, varnishes and printing ink form a large group of products sharing common characteristics regarding legislation cost. In particular, the manufacture of paints and coatings is undergoing increasing pressure to replace lead compounds, previously used in decorative and automotive coatings, and chromates, for their toxicity. Other environmental requirements relate to coatings with high organic solvent content, which impact the troposphere and are progressively being replaced by water-based polymers (under the form of emulsion coating), higher solids content polymers (which requires less solvent), and powder coatings (York University, 2014).

Another group of companies with representation in the interviews and the survey are producers of silicones. Silicones include materials like siloxanes and silanes, which are versatile elements that can take more than 2000 different forms through the production steps. Silicones are considered as durable, reliable and improve the performance of specific products (e.g. their sustainability. They are used across a wide range of products, from personal care/cosmetics to food and medical applications (Centre Européen des Silicones 2014 and York University 2014).

Due to the size of these two groups of products and their representation in the interviews and survey sample, they have influenced to some extent the estimated cost.

Overall, specialty chemicals in absolute terms bear the highest cost among the sectors surveyed in this study, amounting to €3.9 billion, and the second highest in relative terms representing 17% of value added. Compared to gross operating surplus, costs represent around 44%.

The high cost (in relative terms) is mainly due to the lower added value of specialty chemicals (Source: Eurostat – sectorial analysis 2012 – EU 27) due to higher manufacturing costs, and the lower size and turnover of companies operating in the sector who need to comply with a wide range of legislation.

Among all packages, chemical legislation is the most important one, representing 40.6% of the total legislation cost. The technical complexity

and the heterogeneity of chemicals combined with the lower tonnages produced by companies operating this subsector can explain the higher contribution of chemicals legislation to the total costs.

The main source of cost under chemicals legislation is CAPEX, which represents 39% of the chemical legislation cost. CAPEX include equipment, IT systems, labelling and safety data sheets management systems needed to comply with REACH, CLP and the biocides products regulation.

Table 30: Costs by package and comparison with main financial indicators –shares, annual average 2004-2014

Specialty chemicals	%VA	%GOS	% turnover
Chemicals legislation	6.8	17.7	1.5
Energy legislation	1.6	4.1	0.4
Emissions and processes legislation	3.4	8.9	0.8
Workers safety and health legislation	4.6	12.1	1.0
Product specific legislation	0.1	0.3	0.0
Customs and trade legislation	0.0	0.0	0.0
Transport legislation	0.2	0.6	0.1
Total	**16.7**	**43.7**	**3.8**

Source: Authors' elaboration

Administrative burden and monetary obligations represent 28% and 20% of the cost of chemical legislation respectively, and correspond to the REACH and Biocides legislation requirements for registration and REACH, Biocides and CLP for information obligations.

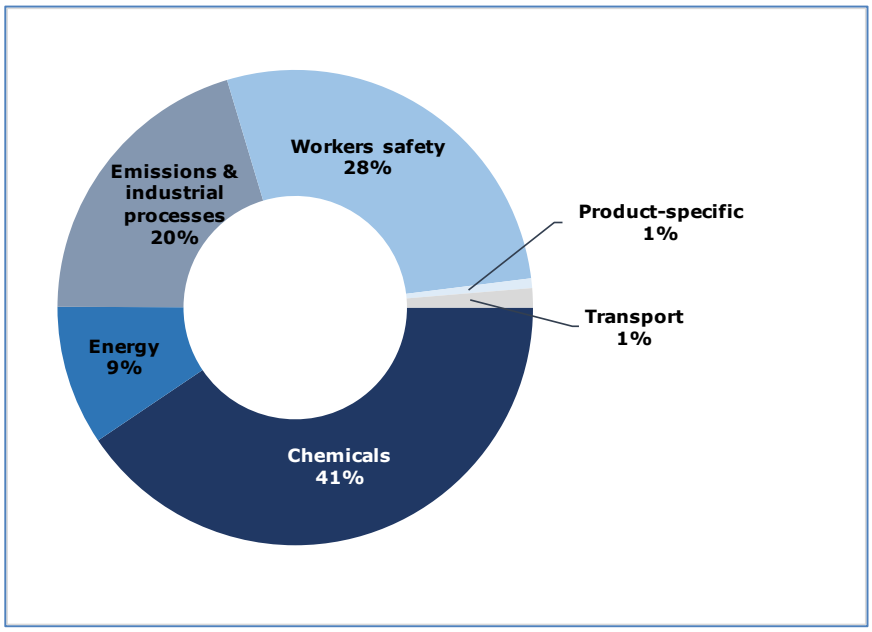
Workers safety and health legislation is the second most important package, representing 30% of the costs, equivalent to 4.6 % of the value added. The main cost categories are operating cost to cover trainings, information systems, safety procedures and visuals (65%). CAPEX (35%) includes systems in place in manufacturing sites such as containment systems, emission abatement techniques, monitoring equipment and all systems in place to enhance workers' safety and protect workers.

Industrial emissions is the third most important package, representing 20% of the legislation cost and 3% of the value added of the subsector. Almost all cost (93%) is driven by investment required by Seveso, industrial emissions, and water and waste Directives.

Cost incurred from legislation under the energy package is also high compared to the other subsectors, representing 9% of the legislation cost and 2% of the value added of the subsector. The main cost drivers are taxes and levies on the energy conception of the specialty chemicals companies, representing 89% of the energy package cost. Unlike companies and production sites operating in subsectors dealing with basic chemicals, companies operating under specialty chemicals do not manage their own energy source like steam or heat. Direct costs result also from

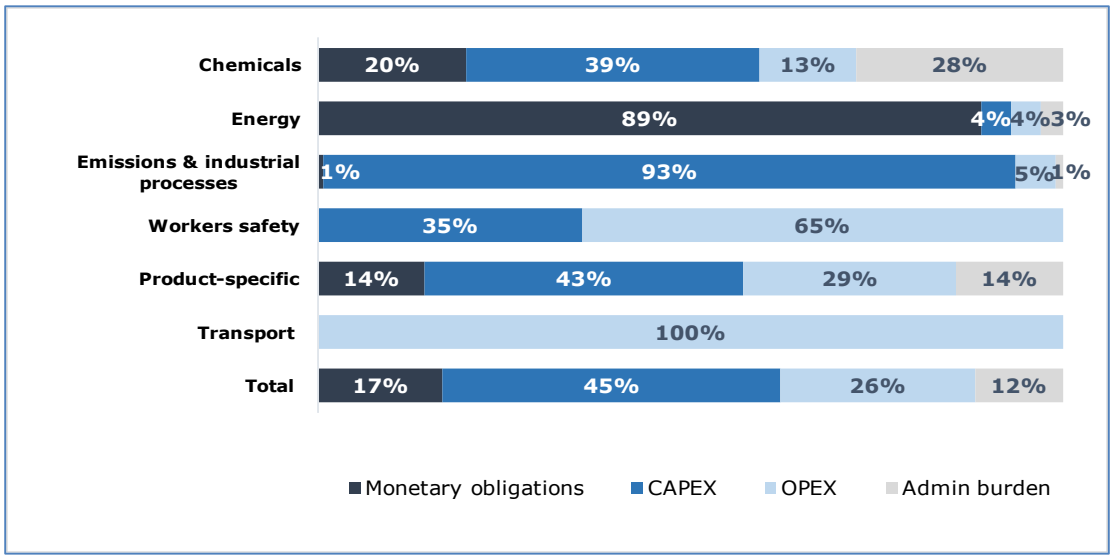
measures related to the Directive on Energy Efficiency, such as energy audits.

Figure 37: Specialty chemicals: Significance of legislation packages –share of cost in total subsector cost, annual average 2004-2014



Source: Authors' elaboration

Figure 38: Specialty chemicals: Significance of cost categories per legislation package – share of package cost, annual average 2004-2014



Source: Authors' elaboration

5.3.5 Cumulative cost for soaps and detergents

Eurostat definition of NACE code 20.41 – Soaps, detergents, cleaning and polishing preparations

The manufacture of soaps, detergents, cleaning and polishing preparations includes the manufacture of organic surface-active agents, of paper, wadding, felt etc. coated or covered with soap or detergent, of glycerol, of soap, except cosmetic soap, of surface-active preparations (washing powders in solid or liquid form and detergents; dish-washing preparations; textile softeners; manufacture of cleaning and polishing products; preparations for perfuming or deodorising rooms; artificial waxes and prepared waxes; polishes and creams for leather; polishes and creams for wood; polishes for coachwork, glass and metal; scouring pastes and powders, including paper, wadding etc. coated or covered with these) (Eurostat, 2015).

Soaps, detergents and cleaning preparations include both household products and products for professional cleaning. Key household products represent 80% of the whole industry and include laundry care, surface care, dish washing and maintenance products, with a value of €28 billion in 2014 for the EU28 plus Switzerland and Norway. Professional cleaning products, accounting for only 20% of European turnover (€6.7 billion), encompass products (mixtures) related to public place cleaning, health care, food/beverage/agriculture, kitchen and catering, technical cleaning and building care (International Association for Soaps, Detergents and Maintenance Products, 2014), with disinfecting or simply cleaning function. The array of applications is very broad, from machine dishwashing powders and tablets, to washing-up liquids and fabric softeners.

The overall legislation cost amounts approximately to €670 million corresponding to 11% of the subsector's value added and is equal to 33% of its profits.

Table 31: Costs by package and comparison with main financial indicators –shares, annual average 2004-2014

Soaps & detergents	%VA	%GOS	% turnover
Chemicals legislation	6.2	18.2	1.4
Energy legislation	0.0	0.0	0.0
Emissions and processes legislation	1.3	3.9	0.3
Workers safety and health legislation	2.4	7.1	0.6
Product specific legislation	0.3	0.9	0.1
Customs and trade legislation	0.0	0.0	0.0
Transport legislation	1.1	3.3	0.3
Total	**11.3**	**33.4**	**2.7**

Source: Authors' elaboration

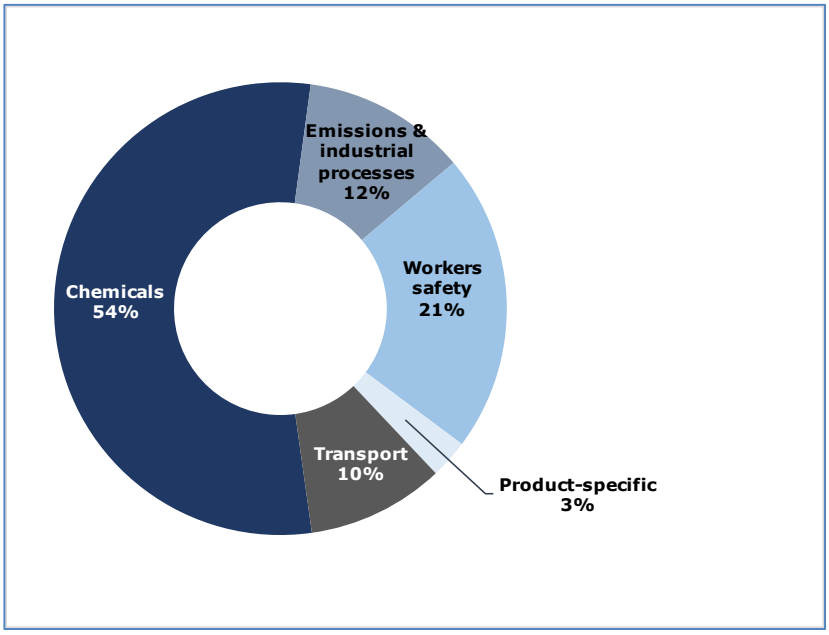
Chemical legislation contributes to 54% of legislation costs, which amounts to 6.2% of the subsector's value added. The most significant costs result from CLP, REACH and Biocides Directives. In particular, information obligations including technical dossiers increase administrative burden, accounting for 43% of the cost of the legislation package. Similarly, these three pieces of legislation are also responsible for CAPEX and OPEX expenses, due to investments and maintenance in laboratory and testing equipment, in IT systems and in labelling equipment. Monetary obligations are driven by REACH and Biocide regulations.

Workers' safety legislation is the second most important package, representing 21% of the legislation costs, equivalent to approximately 2% of the value added. Most of the cost is generated by the obligations for investments on workers' safety and health protection equipment. Individual and collective protective equipment are mandatory in the production of hazardous chemicals. Although most consumer soaps and detergents are exempt from hazard, industrial cleaners and concentrated formulation require safety measures to protect the skin or the respiratory system. Staff training, monitoring of emissions, enclosed production systems, ventilation units, vapour recycling and low volatile compound requirements generate costs that have changed over time. Investments (CAPEX) amount to 34%, while the related operating cost (maintenance and labour cost) is much higher reaching 53% of the package cost. While CAPEX costs are annualised and depreciated over 10 to 15 years from the date of investment, operating costs take place every year and can exceed amortisation of equipment.

Legislation addressing industrial emissions form the third most important source of costs, with a share of 12% of total costs. Requirements from Seveso regulation generate additional CAPEX (41%) and OPEX (35%) costs for soaps and detergents manufacturers due to changes in the Classification and Labelling of concentrated formulations. To lower the environmental footprint of soaps and detergents, producers have implemented measures reducing packaging waste and transport by road. The indirect effect of such measures is a change in the classifications and labelling of detergent formulations. Changes in classification and labelling have triggered changes in the Seveso status of chemical sites producing detergents. More detergent production sites have joined the Seveso status and incurred costs associated with Seveso requirements. Examples of CAPEX and OPEX costs related to Seveso status include special vessels for storage and transport, containment systems and measures preventing accidental release, emergency procedures, training of employees, emergency plans and information systems to the community.

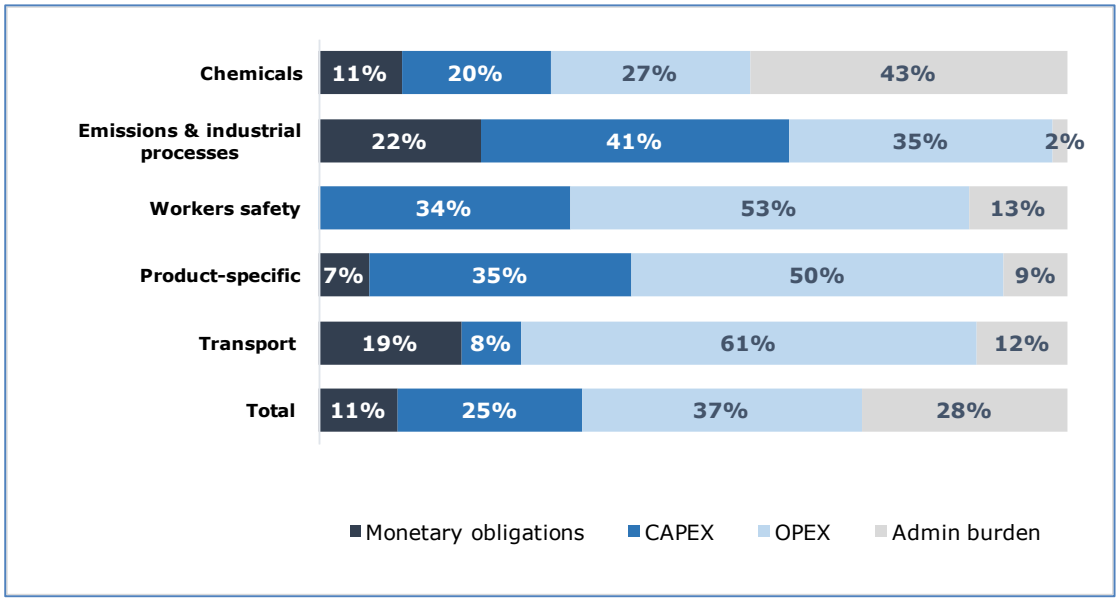
Monetary obligations (22%) result from a combined effect of charges related to REACH and charges resulting from Seveso classification, inspections and audits.

Figure 39: Soaps and detergents: Significance of legislation packages — share of cost in total subsector cost, annual average 2004-2014



Source: Authors' elaboration

Figure 40: Soaps and detergents: Significance of cost categories per legislation package – share of package cost, annual average 2004-2014



Source: Authors' elaboration

The cost generated by the transport regulation is significant compared to other subsectors. With a share of 1% of value added, it is the second highest among the six subsectors. Costs are mainly driven by operating costs (61% of the total package cost) resulting from changes in transport vessels, vehicle labelling, training of transporters and distributors. The source of monetary obligations, amounting to 19%, could result from inspections and audits of transport carriage.

Energy and customs and trade legislation packages were not quantified, as considered less substantial for the subsector.

5.3.6 Legislation cost affecting wholesale activities

Although it is not part of the scope of the study the information collected during implementation of the project allows to draw a broad picture of the **wholesale of chemical products** that could be useful for future studies.

The subsector of wholesale of chemical products allows meeting the demand of more than 1 million downstream users from a wide array of sectors, e.g. pharmaceuticals, detergents, cosmetics or paints. In order to do so, it needs to fulfil most requirements of these related sectors, inter alia those emerging from the chemical legislation. Companies involved in the wholesale of chemical products do not produce chemicals, but mostly trade them. This comprises activities such as chemicals handling, bulk storage, mixing of preparations, on purpose formulations, packaging and transport. Hence, given the nature of these activities, companies distributing chemicals act almost as manufacturers and must comply to the same obligations to prevent impact on health, safety and environment (FECC, 2015).

As chemical distributors play a key role to transfer technical information from chemicals manufacturers to downstream users, cost impacts arise from the generic chemicals package, i.e. REACH and CLP but also from legislation addressing industrial emissions (e.g. from storage), industrial risks, workers' safety and health, customs and trade, transport.

With respect to compliance with REACH, the most resource-intensive legal requirements relate to the pre-registration, notification of Substance of Very High Concern and the preparation, translation and coordination of Safety Data Sheets, along with their update or modification. Moreover, main impacts from CLP come from the labelling and re-classification of substances according to the regulation. Companies from the subsector also flagged the regulation on biocides and environmental regulation as a source of costs. Other important legislation such as dangerous goods-related legislation or life science regulation were mentioned but do not fall under the scope of this exercise.

Multinational chemicals distributors import, handle and store large volume of chemicals including hazardous substances. These organisations must comply with environmental emission limits, safety standards, Seveso requirements, transport regulations, and regulation addressing waste. Compliance with such obligations generates investments in large industrial equipment to control and limit environmental emissions and to ensure the required levels of safety and workers protection. These measures result in

CAPEX and OPEX, employees' trainings, communication with local authorities.

In addition to trade, some chemical distributors also assemble chemicals to produce formulations with specific purposes such as surface cleaning, acting as an active substance carrier or reaction medium for a chemical process, etc. Producing specific chemicals formulations imply obligations comparable to those of chemicals manufacturers covered under this study under specialty chemicals.

Most cost impacts emerge from operating costs of personnel and administrative burden. Human resources addressing regulatory issues on quality, health and safety matters have substantially risen throughout the last decade, along with expanding the use of external services for support. According to a FECC's survey[41], the increase in human resources allocated to quality, health and safety has increased from around 2.3/3 persons in 2004 to 5.8/6 persons in 2014. The survey suggests the costs from 0.64% in 2004 to 1,31% in 2014 in relation to turnover, and from 7.9% in 2004 to 11% in 2014 in relation to net profit.

5.4 Main conclusions

The variability of cost across the different sectors is significant. While it does reflect differences in product groups and their production chains, it mainly reflects differences in the anticipated impact of the subsector on health and safety – of both consumers and employees – and on the environment. Thus, legislation with environmental, health and safety concerns – such as the emissions, chemicals and workers' safety packages – generate almost 88% of the cost. Therefore, it is not surprising that the highest cost as a percentage of value added is observed in pesticides and other agrochemicals, amounting to 23.2%, and the lowest in plastics, at 2.7%.

Within subsectors one could expect variability that reflects the size of companies as well as their organisational structure, efficiency, level of integration and product portfolio. SMEs in general incur higher costs compared to large structures because the costs to comply with legislation are not linear and cannot be amortised on large volumes of chemicals. SMEs tend to outsource expertise and service to external providers. Companies manufacturing hazardous chemicals incur higher costs of compliance.

Administrative burden is mainly related to the cost of the preparation and submission of information for registrations and issue of permits, or for

[41] Internal survey from the European Association of Chemical Distributors (FECC), 2015

product users (e.g. labelling). Overall, it amounts to 10% of the total regulatory cost. Although the administrative burden is the smallest cost category, it affects all subsectors and therefore improvements in the efficiency of the legislation could have an impact on almost all EU chemical industry. Higher administrative burden is observed in soaps and detergents, where it represents almost 28% of the legislation cost and 3.2% of the subsector's value added. Pesticides bear also relatively high administrative burden, representing 14% of the regulatory cost and 3.2% of the value added. It is less important, but its share is higher than the average, for specialty chemicals, amounting to 12% of the regulatory cost and representing 2% of the value added. The cost is mainly driven by the chemicals legislation package, responsible for 75% of the administrative burden, and more specifically by REACH, PPPs, biocides and CLP regulation. However, a noticeable reduction of administrative burden is expected after the final registration deadline of REACH elapses in 2018.

Monetary obligations amount to approximately 20% of the regulatory cost. They include mainly taxes, levies, charges and registration fees. The latter contributes to the financial viability of the monitoring and enforcement system by covering part or all of their cost. (e.g. REACH registration fees cover the cost of maintaining the REACH registration and monitoring system). Out of all monetary obligations, only those stemming from the chemicals legislation package, representing 7% of the total cost, are related to the sustainability of the enforcement and monitoring system. The remaining monetary obligations (representing 13% of cost) are linked directly to energy and environmental policy objectives (taxes and ETS-related allowances).

When restricting the focus to the chemicals package, the highest monetary obligations cost is observed in pesticides and other agrochemicals (25% of the cost), specialty chemicals (8% of cost) and inorganic basic chemicals (7% of cost). The pieces of legislation generating the highest monetary obligations are REACH, PPPs and biocides. Again, as in the case of administrative burden, a reduction is expected after 2018 due to REACH.

CAPEX and OPEX, representing the highest proportion of the legislation cost (approximately 71%), affect all subsectors and are mainly driven by the emissions, chemicals and workers' safety legislation packages. CAPEX and OPEX generated by the emissions and industrial processes package aim at reducing emissions and complying with the best available technique principle. They represent 3.2% of the value added and 27% of the total legislation cost. CAPEX and OPEX driven by the workers' safety and health package aim at improving safety conditions and protection of workers. They represent 2.9% of the value added and 24% of total cost. CAPEX and OPEX generated by the chemicals legislation are mainly driven by CLP and represent 1.7% of the value added and 14% of the total legislation cost. However, similar to REACH registrations, a significant reduction in the costs related to CLP can be expected after the final deadline in 2017.

Progress in science and a better understanding of the potential impact of chemicals on health and the environment trigger changes in the classification of substances published in ATPs. Such changes affect companies' compliance with several legislation packages, requiring additional investments or generating administrative burden. When frequent changes in classification affect the same family of products or the same subsector, the economic impact on the value added can be significant.

Changes in classification are difficult to predict and, therefore, ex-ante impact assessments fail to consider them in their estimation of cost. CAPEX and OPEX are also often overlooked by impact assessments that mainly focus on administrative burden and monetary obligations, which are easier to estimate.

Considering country differences, and removing the effects of the national legislation on the estimated cost, remains a difficult challenge. Particularly in the case of energy taxes, the estimated cost does not differentiate between EU and national policies, so the figures express the total energy taxes paid by companies. The main areas of variability across countries have been observed in energy taxes and the application of the "best available technique" principle. In the former, different tax regimes across countries are combined with sector-specific reimbursements and exemptions within countries. In the latter, some Member States are more flexible than others when they apply the best available technique principle, taking into consideration the local constraints.

In addition to the direct legislation cost, companies also bear indirect legislation cost, which is not part of the estimations in the current study. An important component of the indirect cost is the legislation cost for energy and equipment suppliers, which they pass on to chemical companies through their prices. The opportunity costs due to the withdrawal of substances or the loss of markets are also important, according to the interviewed companies, although difficult to quantify.

The legislation cost over the period 2004-2014 has been rising, with major milestones being the introduction of REACH and CLP in 2007 and 2008 respectively, and investment by companies after 2009 in anticipation of the enforcement of Seveso III in 2012 and ETS Phase 3 in 2013.

Energy legislation also contributes to the cost, especially after 2012. The chemical industry will face stricter emission limit values with more ambitious CO_2 emission reduction targets and energy efficiency objectives, which probably will lead to an increasing compliance cost.

It is expected that CLP and REACH costs will decrease after 2017 and 2018 respectively, while cost of compliance with biocides and plant protection products will continue to expand. Costs of compliance with workers' safety and transport legislation should remain stable.

6 References

ADAS (2006). *Cost analysis of possible changes in pesticides practices,* Report for the UK Pesticides Safety Directorate.

American Chemistry Council (2011). *Guide to the Business of Chemistry*.

Arcadia, Van Dijk, BiPRO (2012). *Study on options to fully harmonies the EU legislation on fertilizing materials including technical feasibility, environmental, economic and social impacts.*

Arthur D. Little (2004). *New Proposals for Chemicals Policy: Effects on the Competitiveness of the Chemical Industry.*

BBC News (2014). *Plans to curb wind turbines onshore will push up electricity bills.*

Bio Intelligence Service (2013). *Analysis of the public consultation on the green paper "European Strategy on Plastic Waste in the Environment".*

Bio Intelligence Service (2013). *Simplification of the EU pesticide regulatory regime.*

CEFIC (2014). *About the European Chemical Industry*. Retrieved October 20, 2014 from http://www.cefic.org/About-us/European-Industry/

CEFIC (2014). *Environment & Health*. Retrieved 2014 from http://www.cefic.org/Policy-Centre/Environment--health/

CEFIC (2014). *How can we manage industrial emissions sustainably?* Retrieved October 2014 from http://www.cefic.org/Policy-Centre/Environment--health/Industrial-Emissions-IED/

CEFIC (2014). *Pushing back the limits of energy efficiency*. Retrieved October 2014 from http://www.cefic.org/Policy-Centre/Energy/Energy-Efficiency/

CEFIC (2013). *The European chemical industry.*

CEFIC (2014). *Facts and figures* 2014. Retrieved from http://www.cefic.org/facts-and-figures

CEFIC, ECOFYS (2013). *European chemistry for growth. Unlocking a competitive, low carbon and energy efficient future.* CEFIC.

CEHTRA (2012). *Report on survey of worldwide CROs: costs and practicalities of two new OECD guidelines for testing chemical substances.*

CEPE – Paints, printing inks and artists' colours in Europe (2015). Figures from the website. Retrieved from www.cepe.org

CEPS (2014). *A study on composition and drivers of energy prices and costs in energy intensive industries: the case of ceramics, flat glass and chemical industries.*

CEPS (2013a). *Assessment of Cumulative Cost Impact for the Steel Industry: Final Report*. Retrieved from http://ec.europa.eu/enterprise/sectors/metals-minerals/files/steel-cum-cost-imp_en.pdf

CEPS (2013b) *Assessment of Cumulative Cost Impact for the Steel and the Aluminium Industry: Final Report Aluminium*. Retrieved from http://www.ceps.eu/system/files/final-report-aluminium_en.pdf

CEPS (2013c). *Assessing the cost and benefits of regulation*. Retrieved from http://ec.europa.eu/smartregulation/impact/commission_guidelines/docs/131210_cba_study_sg_final.pdf

CEPS. (2013d). *REACH: A killer whale for SMEs?*

Centre for Ecology and Hydrology, British Geological Survey, Centre for Chemicals Management, Lancaster Environment Centre, Lancaster University (2006). *The benefits of chemicals regulation, four case studies.*

CONCAWE (2013). *Oil refining in the EU in 2020, with perspectives to 2030.*

Centre for Strategy and Evaluation Services. *Monitoring the Impacts of REACH on Innovation, Competitiveness and SMEs*. Retrieved from http://ec.europa.eu/DocsRoom/documents/14581/attachments/1/translations/en/renditions/native

Centre for Strategy and Evaluation Services. (2012a). I*mpact of the REACH Regulation on the innovativeness of the EU chemical industry.*

Centre for Strategy and Evaluation Services. (2012b). *Interim evaluation: Functioning of the European chemical market after the introduction of REACH: Final report*. CSES. Retrieved from http://ec.europa.eu/DocsRoom/documents/11883/attachments/1/../pd

DEFRA (2010). *Plant Protection Products: Enforcement Regulations and Fees Regulations.*

DEFRA (2011). *Impact assessment Plant Protection Products: Enforcement Regulations and Fees Regulations*

DHI, RPA, OKOPOL (2012). *Assessment of health and environmental benefits of REACH.*

ECHA (n.d.a). Nearly 3 000 more substances registered by industry. In *Newsletter*. Retrieved from http://newsletter.echa.europa.eu/home/-/newsletter/entry/3_13_reach_results

ECHA (n.d.b). Top tips for the CLP 2015 deadline. In *Newsletter*. Retrieved from http://newsletter.echa.europa.eu/home/-/newsletter/entry/6_14_top-tips-for-the-clp-2015-deadline

ECHA (2015). *ECHA's REACH 2018 Roadmap*. Retrieved from http://echa.europa.eu/documents/10162/13552/reach_roadmap_2018_web_final_en.pdf

Ecofys. (2013). *European Chemistry for Growth, Unlocking a competitive, low carbon and energy efficient future. Retrieved from* http://www.cefic.org/Documents/PolicyCentre/ETS/Energy-Roadmap-The%20Report-European-chemistry-for-growth.pdf

Entec. (2010). *UK impact assessment of the proposed biocides regulation*. London: HSE. Retrieved from http://www.hse.gov.uk/research/rrpdf/rr826.pd

Environment, Community and Local Government (2011). *Revised EU Emissions Trading Scheme Directive.*

ERM (2005). *An Impact Assessment of the Proposed EU Chemical Policy (REACH) on Irish Industry*.

EuroChlor (2015), *Figures from the website*. Retrieved from: www.eurochlor.org

European Association of Chemical Distributors – FECC. (2015). *Internal survey on regulatory costs.*

European Climate Foundation. (2014). *Europe's low-carbon transition: Understanding the challenges and opportunities for the chemical sector.*

European Commission. (n.d). Standard Cost Model (SCM). *Reducing Regulatory Burden*. Retrieved from http://ec.europa.eu/smart-regulation/refit/admin_burden/scm_en.htm

European Commission. (2015a). *Better regulation "toolbox"*. Retrieved from http://ec.europa.eu/smart-regulation/guidelines/docs/br_toolbox_en.pdf

European Commission. (2015b, ongoing). *An assessment of the cumulative cost impacts of specified EU legislation and policies on the EU forest-based industries.*

European Commission. (2015c). *Study on the impacts on low-carbon actions and investments of the installations falling under the EU ETS.*

European Commission. (2014a). *Cutting Red Tape in Europe, Final report of the High Level Group on Administrative Burdens.*

European Commission (2014b). *Commission staff working document - Energy prices and costs report.*

European Commission (2014). *Ex-post evaluation of certain waste stream directives.*

European Commission (2013). *Extended impact assessment (REACH).*

European Commission (2013). *General Report on REACH (accompanying document "Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions").*

European Commission (2012). *Review of EU legislation (REACH) concerning nanotechnology – Nano Support Project.*

European Commission (2012). Energy and carbon prices: assessing the impact of energy and climate policies.

European Commission – DG ENV (2011). Assessing the case for EU legislation on the safety of pipelines and the possible impacts.

European Commission (2011). Report on the implementation of the recommendations of the High Level Group on the competitiveness of the European Chemicals Industry.

European Commission (2010a). Impact assessment, accompanying document to the Regulation of the European parliament and of the council on the marketing and use of explosives precursors.

European Commission (2010b). Impact assessment on the use of phosphates and other phosphorous compounds in household laundry detergents.

European Commission (2009a). High Level Group on the Competiveness of the European Chemical Industry. Retrieved from http://ec.europa.eu/enterprise/sectors/chemicals/files/final_report/hlg_final_report_july09.pdf

European Commission (2009b). *Impact assessment guidelines*, SEC (2009) 92. Retrieved from http://ec.europa.eu/smart-regulation/impact/commission_guidelines/docs/iag_2009_en.pdf

European Commission (2009c). *Simplification of EU legislation in the field of textile names and labelling - Impact Assessment Report*.

European Commission (2009d). Impact assessment concerning the placing on the market and use of biocidal products.

European Commission (2008). Impact assessment on the package of implementation measures for the EU's objectives on climate change and renewable energy for 2020.

European Commission (2007). Impact assessment on classification, labelling and packaging of substances and mixtures, and amending Directive 67/548/EEC and Regulation (EC) No 1907/2006.

European Commission (2007b). Impact assessment on on industrial emissions (integrated pollution prevention and control).

European Commission. (2007c). Imposing a unilateral carbon constraint on European energy-intensive industries and its impact on their international competitiveness. DG Economic and Financial Affairs Economic Paper n° 297.

European Commission (2003). Impact assessment on REACH.

European Commission (2003). *A Microeconomic Model to Assess the Economic Impacts of the EU's New Chemicals Policy.*

European Climate Foundation (2014). *Europe's low-carbon transition: Understanding the challenges and opportunities for the chemical sector.*

European Crop Protection Association (2014). Figures from the website. Retrieved from: http://ecpa.eu.

European Petroleum Industry Association (2011). *European White Paper on Fuelling Eu Transport.*

European Renewable Resources & Materials Association (2002). *CURRENT Situation and FUTURE Prospects of EU industry using Renewable raw materials.*

Eurostat (2015a). *RAMON, Reference and management of nomenclatures, Metadata, NACE Rev. 2. Retrieved from* http://ec.europa.eu/eurostat/ramon/nomenclatures

Eurostat (2015b). *Structural Business Statistics, Annual detailed statistics on industry.* Data retrieved in September 2015 from data set sbs_na_ind.

Eurostat. (2015c). *Environmental taxes by economic* activity (NACE Rev. 2). Data retrieved in December 2015 from the data set env_ac_taxind2.

Eurostat (2012). *The (nominal) risk caused by chemicals in 2012 compared to the 2007 (a follow-up of the baseline study of REACH).*

FECC (2015), *European Chemical Distribution Industry Association,* Retrieved from: http://www.fecc.org/

GAIA (2012). *REACH contribution to the development of emerging technologies*. Retrieved from http://ec.europa.eu/DocsRoom/documents/11895/

Home Office (2013). *EU Regulation on the Marketing and Use of Explosive Precursors*.

HSE (2013). *Impact assessment for amending COMAH 1999 to align the thresholds for Heavy Fuel Oil with those of Petroleum Products.*

HSE (2010). *UK impact assessment of the proposed biocides regulation*.

ICF, AMEC (2013). *The potential impact on industrial competitiveness of restrictions on certain CMR 1A and 1B substances in articles -Scoping study for the application of art. 68.2 of REACH to CMR substances requiring priority action.*

IHS (2015). *IHS Chemical Economic Handbook, Overview of the specialty chemicals industry*, July 2015.

Innovest (2007). *Overview of the Chemical Industry: Overview for Coming Clean*, March.

International Association for Soaps, Detergents and maintenance Products (2015). *Market and economic data Figures*. Retrieved from: www.aise.eu

IPTS (2013). *End-of-waste criteria for waste plastic for conversion*.

IPTS (2005). *Implementation of REACH in the new member states.*

Jantzen, J., & van der Woerd, H. (2015). *Environmental expenditures in EU industries*. European Commission. Retrieved from http://ec.europa.eu/environment/enveco/studies.htm#

JRC (n.d). *Best Available Techniques Reference Documents (BREFs) relevant for the chemical production.*

KPMG (2005). *REACH – further work on impact assessment*.

London Economics, DTI, RPA (2006). *Evaluating the Cumulative Impact of Safety, Health and Environmental Regulation on the UK Industrial Coatings, Aerosols and Specialty Chemicals Sectors.*

Matrix Insight Ltd (2014). *A study to support the impact assessment of relevant regulatory options for nanomaterials in the framework of REACH*.

Milieu (2012). *Implementation and enforcement of restrictions in Member States.*

Milieu (2012). *Technical assistance related to the scope of REACH and other relevant EU legislation to assess overlaps.*

Milieu (2011). *Inspections requirements for REACH and CLP.*

Mohr R., Utikal H. (2013). *Future of chemistry*.

Mudgal, S., de Toni, van Long, L., Mitsios, A., Fogleman, V., & Sarigiannis, D. (2013). . *Simplification of the EU pesticides regulatory regime: Final report*. UK Department for Environment, Food and Rural Affairs (DEFRA)

Network Standard Cost Model. (2005). International standard cost model manual. *Measuring and reducing administrative burdens for businesses*. Retrieved from http://www.oecd.org/regreform/regulatory-policy/34227698.pdf

Panteia (2013). *Impact REACH op MKB.* Retrieved from http://www.euconf.eu/reach2013/pdf/presentations/eindrapport_panteia_ivam.pdf

Pelkmans, J., Schrefler, L., & Gubbels, I. (2013). *The consequences of REACH for SMEs*. Luxembourg: European Parliament's Committee on Industry, Research and Energy. Retrieved from http://www.eesc.europa.eu/resources/docs/the-consequences-of-reach-for-smes.pd

Petrochemicals Europe (2015). Figures from the website. Retrieved from www.petrochemistry.eu

PlasticsEurope (2015). *The Facts 2014/2015.* Retrieved from www.plasticseurope.fr

RPA & Okopol (2012). *Technical assistance to prepare the Commission report on operation of REACH.* Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/399115/eu-reach-clp-regs-report.pdf

Rizos, V., Infelise, F., Luchetta, G., Simonelli, F., Stoefs, W., Timini, J., & Colantoni, L. (2014). *Composition and drivers of energy prices and costs in energy-intensive industries: The case of the chemical industry - chlorine. CEPS*. Retrieved from

https://www.ceps.eu/publications/composition-and-drivers-energy-prices-and-costs-energy-intensive-industries-case-0

RPA, Milieu, GnoSys, Arche (2012). *Review of the registration requirements for 1 to 10 tonnes substances and polymers.*

RPA, Milieu, GnoSys (2012). *Review of the registration requirements on polymers.*

RPA (2006). *Impact assessment for CLP*.

PRA (2009). *Scoping Study for the Evaluation of EU REACH and CLP Regulations*

PricewaterhouseCoopers (2012). *Review of the European Chemicals Agency (ECHA)* based on Article 75 of Regulation (EC) N° 1907/2006.

PricewaterhouseCoopers (2012). *Analysis of policies in chemical regions to support the competitiveness of the chemicals industry.*

SIRA. (2015). *CAR methodology manual: A method for identifying regulatory burden within a sector*. Dutch Ministry of Economic Affairs. Retrieved from https://www.government.nl/binaries/government/documents/reports/2015/05/12/car-methodology-manual-a-method-for-identifying-regulatory-burden-within-a-sector/11052015-car-methodology-manual-def.pd

Silicones Europe – Centre Européen des Silicones (2015). Figures from the website. Retrieved from www.silicones.eu

UK Home office (2013). *EU Regulation on the Marketing and Use of Explosives Precursors.*

US International Trade Committee (2014). *Trade carriers that US small and medium sized enterprises perceive as affecting exports to the EU.*

WCA Environment Limited (2011). *On the fees and charges payable to the European Chemicals Agency pursuant to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).*

York University (2014). *The Essential Chemical Industry*.

Annexes

Annex 1: Additional information on cost computation

Adjustment of cost figures with data from the online survey

The online survey allowed collecting data on costs from 90 companies. For each legislation package and cost category (monetary obligations, capital expenditures, operating expenses and administrative burden), companies were asked to select a range of costs (as a percentage of turnover).

The proposed cost ranges had been defined taking into consideration the cost ranges in the panel of companies. Ranges were preferred to exact figures in order to optimise participation rate by facilitating responses and preventing confidentiality issues for the companies.

In order to combine results from the survey with the initial estimates of cost figures, the following calculation was implemented by subsector, size category, legislation package and cost category:

$$Adjusted\ cost = w_1\ Initial\ cost + w_2\ Cost\ in\ survey$$

where w_1 and w_2 are weights for, respectively, the initial estimate and the result from the survey. As the survey only provides ranges for costs, the value used from the survey results corresponds to the middle of the cost range of the 50th percentile of the respondents. This median approach was chosen in order to produce cost figures that are robust to outliers.

Different sets of weights were tested. A lower weight for the survey results was preferred in order to reflect the importance of the validation procedures that were conducted via interviews, workshops and secondary data on initial figures. Furthermore, data collected from the survey are less accurate than data collected via the initial questionnaire as only ranges were reported in the online survey.

The sets of weights that were tested are the following:

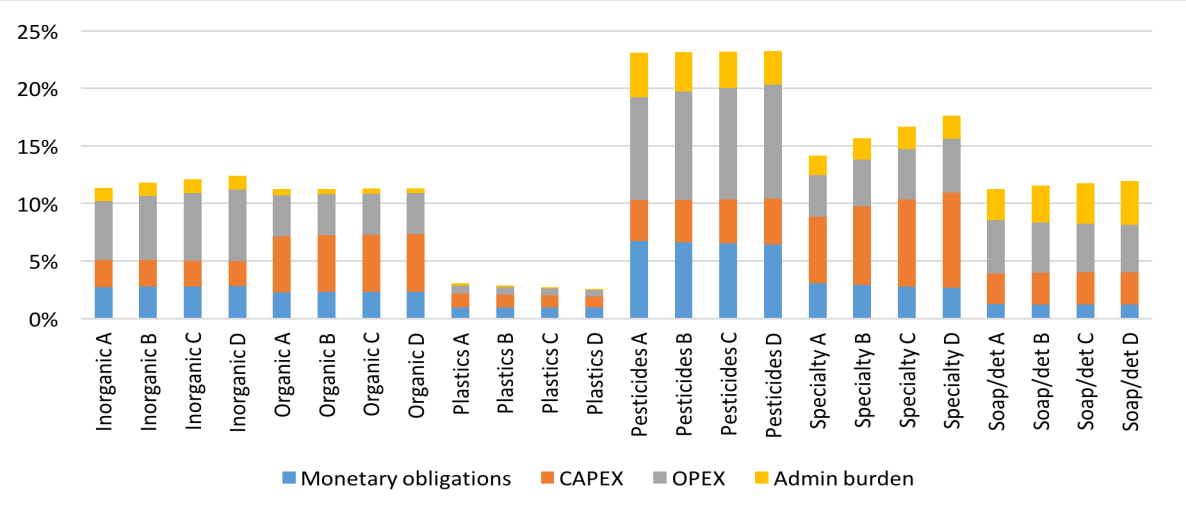
- A: w1 = 50%, w2 = 50%
- B: w1 = 65%, w2 = 35%
- C: w1 = 75%, w2 = 25%
- D: w1 = 85%, w2 = 15%

Figure 41 and Figure 42 present the variation of cost figures according to these different weights. Overall, survey results appear to be in line with the initial estimates in terms of scale. The direction of the adjustments depends on the sector, cost category and legislation package, but no systematic increase or decrease of the initial figures is observed. Results do not appear to be

significantly affected by the choice of the weights, with the exception of the specialty chemicals subsector. This might be due to the heterogeneous composition of the sector.

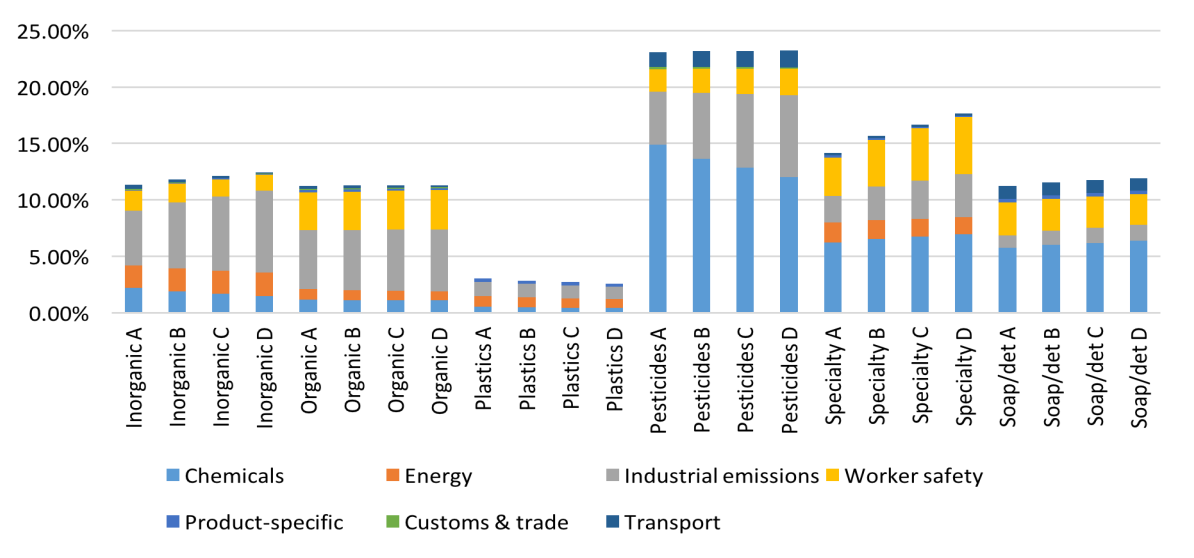
Weights that were selected for producing final figures are 75%/25% as this set of weights seems to be a reasonable compromise between resources invested on ensuring quality of detailed data from the initial questionnaires and the broader coverage of the survey. Furthermore, this choice does not appear to affect the conclusions drawn in this study from the cost figures.

Figure 41 Adjustment of costs according to different sets of weights – by cost category



Source: Authors' elaboration

Figure 42 Adjustment of costs according to different sets of weight – by legislation package



Source: Authors' elaboration

Grossing up cost at EU level

After the adjustment of the dataset received from the panel companies by using the results of the online survey, the estimated cost for each legislation package, subsector and size group was grossed up to the level of EU as follows[42]:

$$GC_{ji} = \frac{AC_{jis}}{T_i s} x\, TEU_{is} \; + \; \frac{AC_{jil}}{T_{il}} \; x\, TEU_{il}$$

Where the *GC* is the grossed up cost, the *AC* is the adjusted cost of panel companies, the *T* is the turnover of panel companies, the TEU is the turnover of EU companies provided by Eurostat and the suffixes *i*, *j*, *s*, *l* stand for the subsectors, the legislation packages, SMEs and large companies respectively.

The number of companies in the subsector was also considered as a direct multiplier for the average absolute cost of a company (instead of relative cost). However, relative costs (as a percentage of turnover) appear to be more stable at the firm level than absolute costs collected. Therefore, grossed up results based on absolute figures are highly sensitive to the selection of companies. Using a scale factor (here turnover) at the company level for expressing costs in relative terms decreases this sensitivity. Turnover was used as scale factor because this indicator is easy to be provided by companies, it can be verified in balance sheets and it is also available in Eurostat.

Grossed up costs were eventually divided by value added, turnover and gross operating surplus published by Eurostat for the different subsectors in order to produce final cost figures.

Estimation of the evolution of cost

In order to produce an estimate of the evolution of costs over 2004-2014, data from the panel companies were used. A subset of cost data for which the year of spending was reported by the companies was elaborated.[43] Hence, all costs used to produce the cumulative figures were not included in the calculation of the trend in time. This approach assumes that costs for which year was not provided are stable in time. Furthermore, data from the online survey were not used to adjust figures for this exercise as no data on precise year of spending was collected via the survey.

[42] Due to lack of data at the company level, chemical tonnage (from PRODCOM) instead of turnover was used as multiplier for companies in the organic sector.

[43] This dataset was created based on annual averages reported by firms as well as the period/years of spending.

An average cost per unit of turnover was calculated each year in comparison with the same average cost in 2004. Average turnover over the last 3 years is used here in order to rescale costs. Evolution of turnover in time is not taken into account.

The ratio between both is presented as an index, which is larger than 1 if costs observed are larger for a given year than in 2004. As all costs were not included in the calculations (only costs which were located in time), changes over time in the index are expected to be amplified, but the direction of the changes and the year when larger increases are observed are still reflected by the index. Moreover, figures used are in nominal values, which implies that the effect of inflation is not removed from the calculations. In addition, the total figure adjusted for inflation using the price deflator of value added for the European chemical sector based on Eurostat's figures is also reported.

Each legislation package is weighted in the index based on the cumulative cost figures for all sectors. The index for year *t* was computed as follows:

$$index_t = \frac{\sum_k w_k \sum_i \left(observed\ costs\ in\ package\ k_{it} \Big/ T_i \right) / n}{\sum_k w_k \sum_i \left(observed\ costs\ in\ package\ k_{i,2004} \Big/ T_i \right) / n}$$

where *w* is the weight estimated as the share of package in the total estimated cost of the chemical sector, T is the turnover provided by the company (used for normalisation at firm level) and the suffixes *i*, *t*, *k*, *n* stand for the firms, the years, the legislation packages and the number of companies in the sample.[44] Petrochemicals companies were added separately as an aggregated group as turnover was not available at firm level.

[44] There is no entry or exit of firms over time.

Annex 2: In-depth questionnaire

Each company received one questionnaire per legislation package for all legislation packages that are relevant to its subsector (Figure 16). The questionnaire per legislation package consisted of two sections:

- An introductory section specific to the legislation package, with a list of the relevant legislation per legislation package,
- A general section with 15 sub-sections each one corresponding to a specific type of cost. The REACH specific questions (Q1.1.4, Q1.1.5, Q3.1.2.5, Q3.1.2.6) appeared only in the chemicals legislation package questionnaire.

In order to support companies in filling in their costs, indicative examples where provided per question.

General section of the questionnaire

Monetary obligations: fees, charges, taxes

Question ID	Question	Description
Q1	Does this legislation impose fees to be paid by your company?	YES/NO
Q1.1	If [YES] What are the fees of the legislation that apply to your company?	Registration fees (Reach - Biocides-Pesticides etc.)
Q1.1.1	Total amount paid to register chemical substances (yearly)	Total amount of net registration fees paid to register chemical substances including pre registration fees
Q1.1.2	How many substances did you register?	Number of registration dossiers
Q1.1.3	What is the average registration fee per substance registered?	Average registration fee per dossier
Q1.1.4	REACH SPECIFIC: How many applications for authorization did you file alone or jointly ?	Number of applications for authorisation (either alone or in a consortium of companies)
Q1.1.5	REACH SPECIFIC: What is the total fee you paid for authorisation?	Average net authorisation fee paid. Note that we refer to **YOUR COMPANY'S SHARE OF THESE COSTS**
Q1.2	Provide the following information	Year of payment of the first fee
Q1.3	Provide the following information	Whether one off or recurrent cost
Q1.4	Provide the following information	Frequency

Question ID	Question	Description
Q1.5	Provide the following information	Determining factors for the calculation of possible yearly variability
Q2	Are there any other charges directly linked to the legislation?	YES/NO
Q2.1	If [YES] What are the charges of the legislation that apply to your company?	Charge name
Q2.1.1	Net charge: burden minus potential subsidy monetized in €	Total net charge paid (Net charges should take in account subsidies or exemptions coming in deduction from the initial charge)
Q2.1.2	Provide the following information	Year of introduction
Q2.1.3	Provide the following information	Whether one off versus recurrent costs
Q2.1.4	Provide the following information	Frequency
Q2.1.5	Provide the following information	Determining factors for the calculation of yearly variability

Substantive obligations: capital expenditures

Question ID	Question	Description
Q3	To comply with the legislation did you have to invest in testing, studies, equipment, systems, procedures or intangibles (e.g. software development, product design etc.)?	YES/NO
Q3.1	If [YES]: What was the level of capital expenditure of your investment?	Provide as much detail as possible on the type of investments (REACH e.g. Laboratories, Reach unit, IT systems, Modelling systems QSAR, testing costs, preparation of dossiers etc.; CLP e.g. Changes in labelling format - new software - New IT and supply chain information systems, Changes in packaging etc.
Q3.1.1	What was the capital expenditure to prepare registration, safety or risk assessment dossiers?	Total costs of technical dossiers.)
Q3.1.2	What was the number of registration, safety or risk assessment dossiers?	Number of technical dossiers

Question ID	Question	Description
Q3.1.2.1	Average costs of testing or data sharing per registration or risk assessment dossier	Typical average cost per technical dossier (all costs included, fees excluded. Otherwise specify origin of costs). Note that we refer to **YOUR COMPANY'S SHARE OF THESE COSTS**
Q3.1.2.2	Management fees paid to participate to registration / risk assessment consortia	Annual fee paid to join consortia
Q3.1.2.3	Fees paid to experts - consultants outside consortium costs	Consultants supporting companies - Toxicologists - cy representative - Reach advisors etc.
Q3.1.2.7	Supply chain information	Cost of IT systems, folders, communication to inform suppliers, distributors and clients etc.
Q3.1.2.8	Other costs	Other costs
Q3.1.3	When did you initiate the investment to comply with regulation?	Insert the start year
Q3.1.3.1	Over which years where investments made and what was the % made per year	Insert year and % share of investment
Q3.1.4	What is the share (%) of this investment dedicated to comply with this legislation	Provide estimates of the % share attributable to the legislation (package and individual legislation)
Q3.2 (BAU)	If [NO]: What was the reason for not making investments to comply with legislation	Examples include e.g. equipment, systems, procedures already in place with adequate performance, higher existing HSE standards, chemicals fully assessed
Q3.2.1 (BAU)	IF (NO): What was the additional capital expenditure invested in anticipation of the upcoming legislation or the additional cost of such investments made as business as usual	Equipment or standards already in place and sufficient to comply with legislation or investments made as business as usual

Substantive obligations: personnel costs

Question ID	Question	Description
Q4.1	To comply with this legislation did you allocate specific existing personnel or hire additional human resources or outsource activities to services with the necessary skills?	YES/NO Personnel costs for engineers, operators, researchers, technicians, project managers, administrative staff
Q4.1.1	If [YES]: How many people do you allocate annually to ensure compliance with the legislation in each of the following qualifications	Technical staff (Note that the number of FTE for the package should be the sum of the individual legislations. The allocation of FTE per legislation should hence be restricted to the indicated legislations. Alternatively in case FTE are indicated for the whole package, % of FTE can be allocated to individual pieces of legislation)
Q4.1.1.1	Insert average annual salary (12 months)	Technical staff
Q4.1.2	If [YES]: How many people do you allocate annually to ensure compliance with the legislation in each of the following qualifications	Management staff (Note that the number of FTE for the package should be the sum of the individual legislations. The allocation of FTE per legislation should hence be restricted to the indicated legislations. Alternatively in case FTE are indicated for the whole package, % of FTE can be allocated to individual pieces of legislation)
Q4.1.2.1	Insert average annual salary (12 months)	Management staff
Q4.1.3	If [YES]: How many people do you allocate annually to ensure compliance with the legislation in each of the following qualifications	Administrative support (Note that the number of FTE for the package should be the sum of the individual legislations. The allocation of FTE per legislation should hence be restricted to the indicated legislations. Alternatively in case FTE are indicated for the whole package, % of FTE can be allocated to individual pieces of legislation)
Q4.1.3.1	Insert average annual salary (12 months)	Administrative support
Q4.1.4	Are external resources contracted to comply with obligations?	YES/NO

Question ID	Question	Description
Q4.1.4.1	If [YES]: what is the annual cost of this service?	External resources
Q4.1.4.2	If [YES]: provide a description of the service	External resources
Q4.1.5 (BAU)	If (NO to Q4.1): Before the introduction of the legislation, how many people did you allocate annually which was sufficient to comply with legislation (business as usual)	Technical staff
Q4.1.6 (BAU)	If (NO to Q4.1): Before the introduction of the legislation, how many people did you allocate annually which was sufficient to comply with legislation (business as usual)	Management staff
Q4.1.7 (BAU)	If (NO to Q4.1): Before the introduction of the legislation, how many people did you allocate annually which was sufficient to comply with legislation (business as usual)	Administrative support
Q4.1.8 (BAU)	If (NO to Q4.1): Before the introduction of the legislation, how many people did you allocate annually which was sufficient to comply with legislation (business as usual)	External resources annual cost

Substantive obligations: operations and maintenance

Question ID	Question	Description
Q4.2	What is the annual cost of operation and maintenance for systems/procedures/equipment installed in order to comply with the legislation?	Annual cost of operations and maintenance of systems required to comply with legislation (e.g. laboratories, Reach unit, IT systems, modelling systems, further testing costs, labelling software - New IT and supply chain information systems)
Q4.2.1	Provide starting year	According to entry into force
Q4.2.2 (BAU)	What was the annual cost of operation and maintenance for systems/procedures/equipment which was sufficient to comply with legislation or investments made as business as usual	According to entry into force

Financial costs

Question ID	Question	Description
Q5	To comply with the legislation did you ask for financial support?	YES/NO
Q5.1	If [YES]: Did you get public support to finance your aforementioned investments?	
Q5.1.1	If you got public support please provide the following information	Form of public support (including conditions) - subsidies, public loans etc.
Q5.1.2	If you got public support please provide the following information	Amount in €
Q5.1.3	If you got public support please provide the following information	Year
Q5.2	If [YES]: Did you get a loan?	YES/NO
Q5.2.1	Please provide the following information	Loan amount
Q5.2.2	Please provide the following information	Duration of loan
Q5.2.3	Please provide the following information	Rate of interest (interest rates reported for financing investment often reflect average rate of equity for industrial investments, or bank loans interest rates. If possible please provide the rate)
Q5.2.4	Please provide the following information	Year of loan

Substantive obligations: recurrent training costs

Question ID	Question	Description
Q6	In order to comply with the legislation and as a consequence of the investments in either, new equipment or new personnel, did you encounter recurrent training costs?	YES/NO
Q6.1	If [YES]: What is the cost of training provided annually with regards to this legislation?	People participating per day
Q6.2	If [YES]: What is the cost of training provided annually with regards to this legislation?	Number of days of training

Question ID	Question	Description
Q6.3	If [YES]: What is the cost of training provided annually with regards to this legislation?	Average Annual salary of people following the training
Q6.4	If [YES]: What is the cost of training provided annually with regards to this legislation?	Annual cost of trainer or external training service

Information obligations: administrative burden

Question ID	Question	Description
Q7	To comply with the legislation did you dedicate specific administrative personnel to handle the day-to-day administrative burden related to information obligations?	Information obligations include reporting to authorities about Reach activities, imports articles, Biocides products, Pesticides etc., CLP declarations, PIC procedures
Q7.1	If [YES]: How many FTE are allocated to information obligations to comply with the legislation?	Average number of persons allocated annually to information obligations
Q7.2	Are external resources contracted to comply with information obligations?	YES/NO
Q7.2.1	If [YES]: what is the annual cost of this service?	
Q7.2.2	If [YES]: provide a description of the service	
Q3.1.2.5	REACH SPECIFIC: Average cost of authorisation dossier	Typical average cost per dossier (all costs included and if not specify origin of costs) **YOUR COMPANY'S SHARE OF THESE COSTS**
Q3.1.2.6	REACH SPECIFIC: Average cost of application dossier (applications of substances)	Typical average cost per dossier (all costs included and if not specify origin of costs). Note that we refer to **YOUR COMPANY's SHARE OF THESE COSTS**

Hassle costs

Question ID	Question	Description
Q8	In implementing the legislation have you experienced delays in operations with financial implications or losses in business?	Examples include e.g. delays in adoption of products classifications, in restrictions on marketing and uses, in authorisations to market, in sites permits for dangerous chemicals etc.
Q8.1	If [YES]: How many days of business have you missed?	Insert the number of business days lost
Q8.2	If [YES]: During which year(s)	Insert years during which delays occurred
Q8.3	What is the equivalent % of turnover lost	

Indirect compliance costs

Question ID	Question	Description
Q9.1	In your opinion are your suppliers affected by the legislation?	YES/NO
Q9.1.1	If [YES]: Do your suppliers pass on the costs of the legislation imposed on them to your company?	
Q9.1.2	For which supply	Consider type of raw material, substance, energy input, waste as raw material, transport or packaging costs
Q9.1.3	By what % has it increased your cost of production?	
Q9.1.4	During which year(s)	
Q9.2	Does your company pass on costs of the legislation to clients?	YES/NO
Q9.2.1	If [YES]: What % of costs of legislation can you pass on to your customers?	

Indirect - Transaction costs

Question ID	Question	Description
Q10	Have you experienced costs arising from delays to identify suppliers or customers and to reach agreements with them as a consequence of the legislation?	YES/NO (Examples include e.g. changes in the pattern of suppliers due to changes in products classification, processes, equipment standards, emission limits, restricted uses etc.)
Q10.1	If [YES]: What is the equivalent % of turnover lost	
Q10.2	If [YES]: During which year(s)	

Indirect - Reduced competition

Question ID	Question	Description
Q11	In your opinion has the amount of competition reduced as a response to the legislation?	Please describe (for example when alternative substances are available in limited quantities or bound to specific license)

Indirect – Market access

Question ID	Question	Description
Q12	In your opinion does the legislation represent a barrier to the entry of new business?	Please describe. Provide as much detail as possible on the type of barrier(s)

Indirect – Substitution costs

Question ID	Question	Description
Q13	As a consequence of the introduction of the legislation did you experience increased costs due to the need to substitute your own source by more expensive alternative sources?	Please describe and quantify if possible (for example Reformulation, R&D, discontinuation of supplies, changes in processes etc.)
Q13.1	If [YES]: what is the % increase of production cost	
Q13.2	If [YES]: During which year(s)	

Indirect – R&D investments

Question ID	Question	Description
Q14.1	Have you increased, reprioritised or reduced R&D expenditures in your company in order to be in a position to comply with the legislation?	Please describe (R&D expenditures)
Q14.2	Have you increased, reprioritised or reduced other investments in your company in order to be in a position to comply with the legislation?	Please describe (Other Investments)

Annex 3: Online survey

In order to validate cost estimates obtained through the in-depth questionnaires, an online survey was launched to gather responses from a larger pool of companies.

Section I: Company information

Companies were requested to provide a short company profile (with information on country of operations, size, etc.). By filling the question on subsector of their main activities, respondents would only see pages with legislative package relevant to their subsector.

1) Please indicate the following information:
The contact information you give here will be treated confidentially and is for information purposes only for the study team.

Name of your company: _____

Contact person: _____

Position in the company: _____

Email address: _____

2) Do you wish to receive further information about the results of the study?

( ) Yes

( ) No

3) Please indicate the country of operation of the production unit:

( ) Austria

( ) Belgium

( ) Bulgaria

( ) Cyprus

( ) Croatia

( ) Czech Republic

( ) Denmark

( ) Estonia

( ) Finland

( ) France

( ) Germany
( ) Greece
( ) Hungary
( ) Ireland
( ) Italy
( ) Latvia
( ) Lithuania
( ) Luxembourg
( ) Malta
( ) Netherlands
( ) Poland
( ) Portugal
( ) Romania
( ) Slovakia
( ) Slovenia
( ) Spain
( ) Sweden
( ) United Kingdom
( ) Others

4) Please indicate the subsector your company belongs to. If more than one is relevant, please select the most important one:

( ) C20.11 Industrial gases
( ) C20.12 Dyes and pigments
( ) C20.13 Other inorganic basic chemicals
( ) C20.14 Other organic basic chemicals
( ) C20.15 Fertilisers and nitrogen compounds
( ) C20.16 Plastics in primary forms
( ) C20.20 Pesticides and other agrochemical products
( ) C20.30 Paints, varnishes and similar coatings, printing ink and mastic
( ) C20.41 Soap and detergents, cleaning and polishing preparations
( ) C20.52 Glues
( ) C20.59 Other chemical products not elsewhere classified
( ) None of the above

5) Size of the company:

( ) Less than 250 employees

( ) More than 250 employees

6) Please indicate the average production tonnage of your company for the subsector indicated above.

Section II : Cost validation by legislative package

Companies were required to fill Section II **for each legislation package** relevant to their subsector based on their answer to the question on subsector (Q4).

Section II consists of **a description of the legislation package** — in the current example the legislation of the Chemicals package is presented — and **questions (7 to 10) applying to all legislation packages**.

<u>Chemicals package (Example)</u>

For each of the following questions, please select the range of costs that best fit your subsector, based on your experience.

List of legislation:

- Council Regulation (EEC) No 793/93 on the evaluation and control of the risks of existing substances (Existing Substances Regulation - in force before Reach)
- REACH Regulation (EC) No 1907/2006
- Directive 67/548/EEC provisions relating to the classification, packaging and labelling of dangerous substances and amending acts including adaptations to Technical Progress (ATP)
- Directive 1999/45/EC relating to the classification, packaging and labelling of dangerous preparations and subsequent amending acts
- CLP Regulation (EC) No 1272/2008 on classification, labelling and packaging
- Biocides Directive (Directive 98/8/EC) + BPR: Biocidal Products Regulation concerning the making available on the market and use of biocidal products (Regulation (EU) No 528/2012)

7) How much on average a company of your subsector is spending per year on fees, charges or taxes as a percentage of its turnover in order to comply with the considered regulation?

( ) No costs

( ) < 0,05%

( ) Between 0,05% and 0,1%

( ) Between 0,1% and 0,5%

( ) Between 0,5% and 1%

( ) Between 1% and 5%

( ) Between 5% and 10%

( ) > 10%

( ) I don't know

8) What percentage of its turnover, a company of your subsector invested on average per year on equipment, testing and systems in order to comply with the legislation?

( ) No costs

( ) < 0,05%

( ) Between 0,05% and 0,1%

( ) Between 0,1% and 0,5%

( ) Between 0,5% and 1%

( ) Between 1% and 5%

( ) Between 5% and 10%

( ) > 10%

( ) I don't know

9) How much on average a company of your subsector is spending per year on human resources, training costs and services as a percentage of turnover, in order to comply with the legislation?

( ) No costs

( ) < 0,05%

( ) Between 0,05% and 0,1%

( ) Between 0,1% and 0,5%

( ) Between 0,5% and 1%

( ) Between 1% and 5%

( ) Between 5% and 10%

( ) > 10%

( ) I don't know

10) How much on average a company of your subsector is spending per year in order to fulfil its obligations to provide information to the authorities such as applications, notifications, reports, registrations (registration fees are excluded) etc., as a percentage of turnover?

( ) No costs

( ) < 0,05%

( ) Between 0,05% and 0,1%

( ) Between 0,1% and 0,5%

( ) Between 0,5% and 1%

( ) Between 1% and 5%

( ) Between 5% and 10%

( ) > 10%

( ) I don't know

ET-04-15-869-EN-N

Publications Office

doi:10.2873/649728