REVIEW OF REACH
REGISTRATION REQUIREMENTS FOR SUBSTANCES MANUFACTURED OR IMPORTED BETWEEN 1 AND 10 TONNES

070307/2011/602175/SER/D3

Final Report
Part B: 1 to 10 Tonne Substances

Prepared for

European Commission
DG Environment

milieu
ENVIRONMENTAL LAW & POLICY

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ASSESSING RISKS OF CHEMICALS

RPA

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Review of REACH Registration Requirements for Substances Manufactured or Imported between 1 and 10 Tonnes 070307/2011/602175/SER/D3

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by

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1. INTRODUCTION

1.1 Background to the Study

1.1.1 Introduction to REACH

Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH[1]) came into force on 1 June 2007. REACH aims to provide a high level of protection of human health and the environment, while at the same time enhancing the competitiveness and innovative capability of the EU industry. Furthermore, REACH aims to ensure the free movement of substances and the promotion the development of alternative methods for the assessment of hazards of substances (Article 1).

The regulation applies to substances manufactured, placed on the market and used in the EU either on their own, in mixtures or in articles (Article 1). Furthermore, REACH is based on the principle that it is for industry *to ensure that they manufacture, place on the market or use such substances that do not adversely affect human health or the environment. Its provisions are underpinned by the precautionary principle* (Article 1(3)).

The four key elements in REACH are:

- **Registration:** of substances manufactured or imported in amounts starting at 1 tonne per year (per manufacturer or importer) (Title II). Notifications of substances by companies under Directive 67/548/EEC are considered to be registrations under REACH (Article 24);

- **Evaluation (Title VI):** of which there are two types – dossier evaluation and substance evaluation;

- **Authorisation:** of substances of very high concern, assuring that the risks of SVHCs are properly controlled and that these substances are progressively replaced, while ensuring the good functioning of the internal market (Title VII); and

- **Restriction:** aimed at addressing risks not adequately controlled on a Community wide basis (Title VIII).

Registration under REACH is staged over three phases, as set out in Chapter 5 of Title II. Of particular relevance for this study is that the final phase-in registration deadline will be 1 June 2018 for substances manufactured or imported in quantities starting at 1

[1] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 200/21/EC (REACH).

tonne but less than 100 tonnes per year per manufacturer or importer. To qualify for the transitional phase-in provisions set out in Article 23(3), manufacturers and importers had to pre-register their intention to register substances to ECHA between 1 June 2008 and 1 December 2008, as set out in Article 28.

1.1.2 Reviews Under Article 138

Obligations were placed on the Commission to undertake a range of reviews of the operation of REACH, with these set out in Article 138. The reviews of specific concern for the assessment of substances registered in quantities greater than or equal to one tonne and less than 10 tonnes per year per manufacturer or importer (1 to 10 tonne substances) are those required under Article 138 sections 1 and 3, as described below.

Article 138(1)

By 1 June 2019, the Commission shall carry out a review to assess whether or not to extend the application of the obligation to perform a chemical safety assessment and to document it in a chemical safety report to substances not covered by this obligation because they are not subject to registration or subject to registration but manufactured or imported in quantities of less than 10 tonnes per year. However, for substances meeting the criteria for classification as carcinogenic, mutagenic or toxic for reproduction, category 1 or 2, in accordance with Directive 67/548/EEC, the review shall be carried out by 1 June 2014. When carrying out the review the Commission shall take into account all relevant factors, including:

(a) the costs for manufacturers and importers of drawing up the chemical safety reports;
(b) the distribution of costs between actors in the supply chain and the downstream user;
(c) the benefits for human health and the environment.

On the basis of these reviews, the Commission may, if appropriate, present legislative proposals to extend this obligation.

Article 138(3)

The report, referred to in Article 117(4), on the experience acquired with the operation of this Regulation shall include a review of the requirements relating to registration of substances manufactured or imported only in quantities starting at 1 tonne but less than 10 tonnes per year per manufacturer or importer. On the basis of that review, the Commission may present legislative proposals to modify the information requirements for substances manufactured or imported in quantities of 1 tonne or more up to 10 tonnes per year per manufacturer or importer, taking into account the latest development, for example in relation to alternative testing and (quantitative) structure-activity relationships ((Q)SARs).

1.2 Study Objectives and Organisation of this Report

The objective of this study, as set out in the Specifications, is:

> *"…to provide technical, scientific and policy support to the Commission to undertake the reviews described in Articles 138(1), (2) and (3) of REACH."*

In particular, this element of the study (Task B) is to review the registration requirements for 1 to 10 tonne substances, within the framework of the June 2012 report of the Commission required under Article 117(4).

The remainder of this report has been organised as follows:

- **Section 2** provides background information on the EU chemicals industry;
- **Section 3** sets out the current information requirements for 1 to 10 tonne substances;
- **Section 4** details potential reductions in and extensions to the information requirements for 1 to 10 tonne substances;
- **Section 5** explains the application of approaches other than testing, especially testing on vertebrate animals, to fulfil the information requirements for registration;
- **Section 6** summarises the available data on substance properties, which is used to predict the degree to which substances manufactured or imported at less than 10 tonnes per year are likely to have hazardous properties;
- **Section 7** details the options considered for this study and the model developed to help assess their costs and associated benefits;
- **Section 7** presents the estimated costs of implementing each of the options, with this including consideration of their potential impacts on innovation and competition;
- **Section 8** presents the predicted benefits of each option, starting with an indication of the number of substances that would be newly identified as having hazardous properties;
- **Section 9** provides a comparative summary of the options, taking into account both their costs and benefits;
- while **Section 10** lists supporting references, with this followed by Annexes providing more detailed information on European Union legislation that has linkages to the types of information generated by REACH.

2. EUROPEAN CHEMICALS INDUSTRY

2.1 Introduction

Data stored on the Eurostat database has been used to obtain data on employment and trade, and these data are grouped under NACE codes. However, the NACE codes used have changed over recent years and the data presented here is therefore grouped under version 1.1 codes, and version 2 codes. These two versions have different coding but similar (not identical) grouping. Where such data is presented, the NACE code version and accompanying description are provided for clarity.

The European chemicals industry produces 21% of the world's chemicals and created €491 billion for the economy of the European Union in 2010 (Cefic, 2011). Currently, eight Member States account for 90% of EU chemicals production, while the remainder of the market is divided between the other 19 Member States. Figure 3.1 illustrates the distribution of the EU chemicals market, showing that the eight largest chemicals producers in the EU collectively generated €437 billion in chemical sales in 2010, while the remaining 19 Member States represented generated €54 billion (Cefic, 2011).

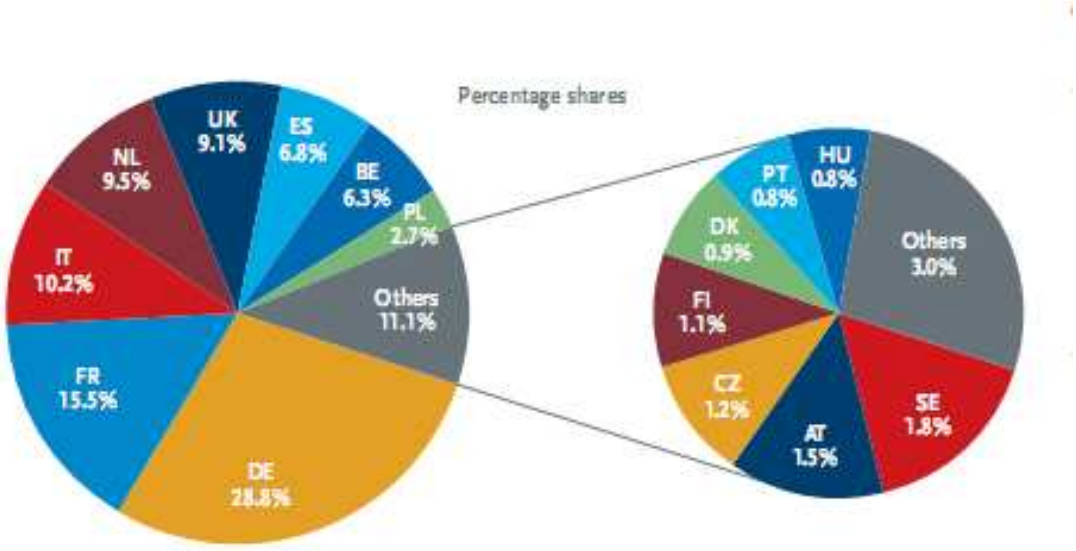

Figure 2.1: European Chemicals Market -
Percentage Shares by Member States in 2010, reproduced from Cefic (2011)

EU chemical manufacturing includes the production of base chemicals, specialty chemicals and consumer chemicals, and according to Cefic (2011) total EU chemicals sales can be subdivided by value as follows:

- Specialty chemicals – 25.6%;
- Polymers – 24%;
- Petrochemicals – 24%;
- Base inorganics – 13.6%; and
- Consumer chemicals – 12.8%.

It is estimated that 27,000 companies (excluding pharmaceutical companies) are active within the EU chemicals industry and have approximately 1.2 million employees (Cefic, 2010). In terms of direct employment, based on data from 2007, the European chemicals industry accounts for 5.4% of the total employment generated by the EU manufacturing sector. Importantly, unlike other manufacturing sectors, the chemicals industry boasts a skilled and highly trained workforce; consequently the chemicals industry has the highest labour cost per employee in the EU manufacturing sector (Cefic, 2011).

2.2 Size Distribution of the Chemicals Industry

2.2.1 Introduction

Irrespective of the high labour costs, companies with less than 250 employees (potential SMEs[2]) are said to dominate the European chemicals industry, accounting for 96% of the 27,000 companies in the industry. In this respect, there is evidence from the Italian chemical industry that SMEs are concentrated in the fine and speciality chemicals sectors where they are able to focus on high value, low volume, tailor made products (Federchimica, 2008).

Table 2.1 presents a breakdown of the chemicals industry according to classifications based on the number of employees.

Table 2.1: Size Class Distribution and Associated Percentage of Total Employment

	Percentage of Chemical Companies[1] (Whole Manufacturing Sector)[2]	**Percentage of Total Employment[1] (Whole Manufacturing Sector) [2]**
SMEs		
Micro (1-9)	63% (81%)	4% (14%)
Small (10-49)	23% (15%)	10% (20%)
Medium (50-249)	10% (4%)	23% (25%)
Large (250+)	4% (1%)	63% (41%)

Sources:
1. Cefic (2010) – figures calculated from data published by Eurostat and refer to NACE (v.2) Code C20 (Cefic, *pers. comm.).*
2. PLANET (2010) – figures calculated from data published by Eurostat and UK DTI estimations.

From the data presented in Table 2.1, it is evident that SMEs (with less than 250 employees) account for the majority of the companies in the chemicals industry. However, it is the large companies which dominate in terms of employment, with 4% out of the total number of companies accounting for 63% of employment in the sector. Out of the percentage that is comprised of large companies: 2.1% have 250-499 employees; 1.1% has 500-999 employees and only 0.7% has 1000 or more

[2] As defined by Commission Recommendation 2003/361/EC concerning the definition of micro, small and medium-sized enterprises (COM, 2003c).

employees. In addition, large companies account for 70% of total sales while SME companies, although representing the majority of operators in the sector, only account for 30% of sales.

It is also noted that the company profile for the chemical industry differs greatly from that of the manufacturing sector as a whole. Micro industries make up 81% of manufacturing companies but only 63% of chemical companies. Micro industries are also responsible for 14% of employment in the manufacturing sector as a whole but account for only 4% of chemical sector employment. Instead, within the chemicals sector, the proportion of small, medium and large companies and their contribution to overall employment is greater than for manufacturing as a whole. Table 2.2 sets out the numbers and percentages of companies, corresponding to the percentages displayed in Table 2.1, but subdivided into NACE (v.2) codes C20.1 and C20.2.

Table 2.2: Companies Manufacturing Substances, by Sector and Size of Company[1]

NACE (v.2) Code (Sector Description)	Number of Employees (%)				
	Micro	**Small**	**Medium**	**Large**	**All**
C20.1 (Manufacture of Basic Chemicals, Fertilisers and Nitrogen Compounds, Plastics and Synthetic Rubber in Primary Forms)	5,612 (62%)	2,019 (22%)	987 (11%)	400 (4%)	**9,018 (100%)**
C20.2 (Manufacture of Pesticides and other Agrochemical Products)	415 (63%)	147 (22%)	79 (12%)	21[2] (3%)	**662 (100%)**

Source: Eurostat (SBS) data for 2010.

Notes:

1. SMEs identified based on number of employees only.
2. 2009 data.

It is expected that the majority of SMEs falling under these two NACE codes are in fact active in the downstream section of the supply chain or are articles producers rather than being producers of chemicals. For example, Chemsec (2012) reports that around 0.3% of all European SMEs are chemical producers. More specifically, Cefic (2006) data suggests that 25% of SMEs (6,317) in the chemicals industry can be considered producers of substances, with the remaining 75% considered to be formulators (assumed to be based on 2004 data); however, questions have been raised in the past regarding how these figures were established.

Data previously developed by RPA includes estimates of the number and percentage of SMEs in different sub-sectors of the EU chemical industry (RPA, 2006). These data are presented in Table 2.3.

Table 2.3: Number and Percentage (of total) Chemical Sector SMEs[1] by Sub-sector		
Sector	**SMEs**	
	No.	**%**
Basic Chemicals	3,948	54
Agrochemicals	311	60
Paints & Inks	138	3
Consumer Chemicals	450	6
Other Chemical Products	1,391	21
Man-made Fibres	79	29
Total	6,317	24
Note 1: Based on number of employees only.		

2.2.2 Germany

As was previously mentioned, Germany is the largest chemicals producing Member State in the EU, with an estimated market share of 28.8%. According to the VCI (Verband der Chemischen Industrie e.V., German Chemicals Industry Association) a large proportion of the German chemicals industry is made up of SMEs akin to the structure of the European industry. It is estimated that there are 2,000 companies which *"manufacture chemical products in Germany"* (VCI, 2011). Of these 2,000 companies, it is estimated that 90% are smaller companies with less than *500* staff (no data is provided on the number of companies with less than 250 employees).

Table 2.4 is reproduced from the earlier RPA report on REACH (RPA, 2006) and breaks down older data on the number of SMEs in the German chemicals industry further, providing a greater focus on those actually involved in the manufacture of chemical substances rather than in formulation, distribution, or other activities. As can be seen from this table, the number is significantly smaller at 312 than might be assumed on the basis of the 2011 report by the VCI (90% of 2,000 could be taken to suggest 1,800 SMEs involved in chemicals manufacture).

Table 2.4: Substance Manufacture by SMEs in Germany (RPA, 2006)				
Sector and NACE (v 1.1) Code	**Number of SMEs[1] in sector**	**Percentage of SMEs**	**No. of SME Companies Manufacturing Substances[2]**	**Percentage of SME Companies Manufacturing Substances**
Basic chemicals	223	26	181	81
Pesticides	15	2	14	93
Paints	184	21	9	5
Consumer chemicals	193	22	19	10
Other chemicals	233	27	82	35
Man-made fibres	20	2	7	35
Total	868	100	312	-
Notes: 1. Based on number of employees only. 2. Estimated by experts from the relevant sector associations.				

Based on the above data, it appears that the German industry has a structure similar to the European industry as a whole. Furthermore, according to the VCI, a particular strength of the SMEs in the industry is in custom chemicals for specialised applications; they manufacture 24,000 different products in quantities less than 100 tonnes annually (VCI, 2011b).

2.2.3 France

The chemicals industry in France accounts for 15.5% of the total European market. According to the UIC (Union des Industries Chimiques/ Union of Chemical Industries), 3,350 companies are active in the French chemicals industry, with 94% of these with less than 250 employees and so potential SMEs (UIC, 2012). According to the Observatoire des Industries Chimiques (Observatory of the Chemical Industries, 2009) SMEs are over-represented in the industry.

The structure of the chemicals industry in France is reported to be divided as follows (Observatoire des Industries Chimiques, 2009):

63% of companies have less than 20 employees;
24% of companies have between 20 and 100 employees;
10% of companies have between 100 and 500 employees; and
3% of companies have over 500 employees.

No data was found regarding the number of SMEs actually involved in the manufacture of chemicals, as opposed to formulation, distribution, etc. in France. Nor was data found that more closely matched the EU definition of SMEs.

2.2.4 Italy

The Italian chemicals industry accounts for 10.2% of the European chemicals industry and employs 115,000 people in an estimated 3,000 companies (Federchimica, 2011). According to Federchimica (Federazione Nazionale dell'Industria Chimica/ National Federation of the Chemical Industry) (2008), the Italian chemicals industry can be divided into three groups:

- Italian SMEs (which account for 41% of the total value of production);
- Italian medium and large companies (22% of the total value of production); and
- Foreign owned companies (37% of the total value of production) (*importantly there is no clarification as to the size of such companies; as a result it is not possible to conclude that only 41% of companies are SMEs).*

Federchimica (2008) note that SMEs in the Italian chemicals industry are particularly active in fine and specialty chemicals where scale economies are not very relevant and the key to success often consists of offering customers tailor made products.

2.2.5 UK

The UK chemicals industry accounts for 9.1% of the total European chemicals industry. It is estimated that turnover from the UK chemicals industry exceeds £57 billion and over 180,000 people are employed in 3,000 organisations across that Member State. According to the CIA (Chemical Industries Association), only 160 companies currently employ more than 250 people; therefore, similar to the European industry, the majority of the industry is made up of companies with less than 250 employees (i.e. potential SMEs) (CIA, 2012). Unfortunately, there is no data which clarifies specifically the number of SMEs actually involved in chemicals manufacture as opposed to other activities.

2.2.6 Spain

The chemicals industry in Spain accounts for 6.8% of the European chemicals industry. Table 2.5 provides data on the size of the companies within the Spanish industry based on the number of employees and the percentage of the market each size classification accounts for. These data are reproduced from Feique, the Federation of Employers of the Spanish Chemicals Industry (Federación Empresarial de la Industria Química Española), and cover all companies involved in the chemicals industry and not just chemicals manufacturers.

Table 2.5: Size of Companies in the Spanish Chemicals and Pharmaceuticals Industries

Number of Employees	Number of Companies	Percentage of Total
Less than 10	1,809	54.6
10-19	521	15.7
20-49	514	15.5
50-99	210	6.3
100-199	116	3.5
200-499	102	3.1
500-999	30	0.9
1,000 or more	9	0.3
Total	3,311	100

Source: reproduced from Feique (2011)

Although it is not possible from the data presented in Table 2.5 to establish the precise percentage of SMEs in the industry, it can be deduced that SMEs are likely to dominate, with 95.6% of companies having less than 200 employees. Consequently, as for other counties, SMEs can be assumed to constitute the majority of companies in the chemicals industry in Spain; again though, it is not known what percentage are actually manufacturers of chemicals rather than formulators or other downstream users.

2.2.7 Estimated Number of Manufacturers and Importers in Europe

In order to proceed with the Impact Assessment of different information requirements for substances manufactured and imported in quantities of between 1 and 10 tonnes,

estimates on the number of manufacturers and importers in the European Union have been made, on the basis of the EUROSTAT Structural Business Statistics database. The main problem is to avoid the double counting of the manufacturers and importers, as it is common for a manufacturer of basic chemicals to also be importing other substances. Data on the number of such REACH duty holders are not available at national level, as highlighted in the previous sections, so a set of assumption is needed to proceed with an estimate.

To estimate the number of manufacturers who are likely to be registrants of substances, the following NACE codes have been selected:

- C19.20: Manufacture of refined petroleum products;
- C20.11: Manufacture of industrial gases;
- C20.12: Manufacture of dyes and pigments;
- C20.13: Manufacture of other inorganic basic chemicals;
- C20.14: Manufacture of other organic basic chemicals;
- C21.10: Manufacture of basic pharmaceutical products;
- C23.14: Manufacture of glass fibres;
- C23.20: Manufacture of refractory products;
- C24.41: Precious metals production;
- C24.45: Other non-ferrous metal production.

There are other NACE codes likely to comprise potential REACH registrants (for example: C23.5 Manufacturer of cement, lime and plaster, C23.9 Manufacture of abrasive products and non-metallic mineral products, C24.10 Manufacture of basic iron and steel and ferro-alloys, C24.43 Lead, zinc and tin production, C24.44 Copper production) but they were not considered to include manufacturers producing chemicals in quantities below 10 tonnes, or other NACE codes where it is possible that some companies will have to register some substances resulting from their manufacturing process (for example: C10 Manufacture of food products, C11.01 Manufacture of distilling, rectifying and blending of spirits) but in order to be conservative in the estimates, they were not considered here. Registrants could also be manufacturers of articles containing substances in quantities totalling over 1 tonne per producer per year, but no data were found to provide a basis for an estimate.

The number of importers (only representatives) is assumed to be 6% of the sum of number of manufacturers and number of companies in the wholesale of chemical products (G46.75 Wholesale of chemical products, G46.76 Wholesale of other intermediate products), based on information from REACH-EN-FORCE-1[3]. It is likely that companies included in other NACE codes import substances in quantities of between 1 and 10 tonnes (for example: G46.71 Wholesale of solid, liquid and gaseous fuels and related products, G46.72 Wholesale of metals and metal ores, G46.73 Wholesale of wood, construction materials and sanitary equipment, G46.77

[3] 6% is the percentage of "pure" importers on the total number of visited companies that was found during the REACH-EN-FORCE-1 project. ECHA (2010): *Results of the Forum coordinated REACH enforcement project on registration, pre-registration and safety data sheets*, Forum for the Exchange of Information on Enforcement, 2010, pag.6.

Wholesale of waste and scrap) but in order to be conservative in the estimates, they were not considered.

Table 2.6 provides the number of manufacturers by size of the companies in the EU27 in 2009, estimates for the number of importers and the rounded total. Microenterprises are 64% of the total, small enterprises 22%, medium 10% of the total, while only 4% (around 350 companies) are large enterprises.

Table 2.6: Number of manufacturers and importers of substances in quantities of between 1 and 10 tonnes in the EU27 by size of the companies (2009 data)

	Micro	**Small**	**Medium**	**Large**	**Total**
C19.20: Manufacture of refined petroleum products	663	246	119	75	1,123
C20.11: Manufacture of industrial gases	700	241	111	33	1,085
C20.12: Manufacture of dyes and pigments	370	127	59	18	574
C20.13: Manufacture of other inorganic basic chemicals	658	226	104	31	1,020
C20.13: Manufacture of other organic basic chemicals	1,354	465	214	65	2,098
C21.10: Manufacture of basic pharmaceutical products	374	240	131	55	800
C23.14: Manufacture of glass fibres	455	85	20	5	565
C23.20: Manufacture of refractory products	696	129	31	7	863
C24.41: Precious metals production	374	148	76	28	647
C24.45: Other non-ferrous metal production	433	171	88	32	749
Manufacturers	6,077	2,079	953	349	9,524
Importers	2,496	457	110	27	3,093
Total (rounded)	**8,600**	**2,500**	**1,100**	**400**	**12,600**

Source: EUROSTAT Structural Business Statistics database

3. CURRENT REQUIREMENTS FOR 1 TO 10 TONNE SUBSTANCES

3.1 Introduction

In order to be able to assess the possible costs or benefits from any options to amend the registration requirements for 1 to 10 tonne substances, it is essential to establish a detailed understanding of the **baseline situation**, i.e. the current situation assuming that an 'existing requirements' approach is adopted. For this study, the baseline corresponds to taking no action at EU level to amend the REACH with regards to the registration requirements for 1 to 10 tonne substances.

3.2 Information Requirements for 1 to 10 Tonne Substances

3.2.1 Overview

The information requirements for the registration of substances manufactured or imported in quantities between 1 tonne and 10 tonnes per year per registrant are set out in Article 10 and Article 12(1) of REACH.

3.2.2 Article 10 Requirements

All registration dossiers must include the information required for a technical dossier to be submitted for general registration purposes, as set out in Article 10 of REACH, and elaborated in Annex VI. The requirements set out in Article 10 are summarised in Box 2.1.

Box 2.1: Information Requirements as set out in Article 10

(i) identity of the manufacturer(s)/importer(s) (Section 1 of Annex VI).

(ii) identity of the substance (Section 2 of Annex VI).

(iii) information on the manufacture and use(s) of the substance (Section 3 of Annex VI).

(iv) the classification and labelling of the substance (section 4 of Annex VI).

(v) guidance on safe use of the substance (Section 5 of Annex VI).

(vi) study summaries of the information requirements from Annexes VII to XI.

(vii) robust study summaries of the information used to meet the requirements of Annexes VII to XI, (> 10 tonne substances only).

(viii) an indication as to which of the information submitted under Article 10 has been subject to independent assessment.

(ix) proposals for testing where listed in Annexes IX and X (> 100 tonne substances only).

(x) for substances in quantities of 1 to 10 tonnes, exposure information as specified in section 6 of Annex VI.

(xi) a request as to which of the information should not be made available on the Internet.

Article 10 also sets out the requirement to submit a chemical safety report, separate from the technical dossier. However, this requirement does not apply to substances registered in quantities less than 10 tonnes per year.

Under Annex VI, registrants are required to identify themselves (as set out in Section 1) and to identify the substance being registered (as set out in Section 2). The Information required under Sections 3, 4, 5 and 6 of Annex VI are summarised in Box 2.2.

Box 2.2: Information Requirements for Substance Registration as set out in Sections 3, 4, 5 and 6 of Annex VI

Section 3: Information on Manufacture and Uses

- estimates of overall quantities used for the production of an article that is subject to registration (tpa per registrant);
- article manufacturers or producers must provide a brief description of the technological process used but precise details of the process, particularly those of a commercially sensitive nature, are not required;
- an indication of the amount for registrants own use(s)
- form (substance, mixture or article) and/or physical state under which the substance is made available to downstream users;
- concentration or concentration range of the substance in mixtures made available to downstream users;
- quantities of the substance in articles made available to downstream users.
- a brief general description of the identified use(s);
- information on waste quantities and composition of waste resulting from manufacture of the substance, the use in articles and identified uses; and
- uses advised against.

Section 4: Classification and Labelling

The following classification, and labelling, but not packaging, information is required:

- hazard classification under CLP for all hazard classes and categories. However, no classification may be given for a hazard class (or sub-class) where such omissions can be justified, i.e. where data are lacking, inconclusive, or conclusive but not sufficient for classification;
- details of the hazard label under CLP; and
- specific concentration limits, under CLP and DPD, where applicable to the hazard classification of mixtures.

Section 5: Guidance on Safe Use

Information to be consistent with that in SDS, if SDS is required(i.e. where classified under CLP or DPD, PBT/vPvB, or identified as SVHC of equivalent concern):
appropriate measures recommended for first-aid, fire-fighting, accidental release control, handling, storage and transport.
Where no CSR is required, additional information is needed on exposure controls, personal protection, substance stability, substance reactivity, safe disposal (recycling and disposal methods recommended for industry and the public).

Section 6: Exposure Information (1 to 10 Tonne Substances Only)

Information relating to the main use category is needed:

- industrial use, professional use; and/or consumer use;
- specification of whether industrial and professional use can include use; in closed system, resulting in inclusion into or onto matrix, non-dispersive and/or dispersive;
- significant route(s) of exposure to humans (via oral, dermal, and/or inhalation routes);
- signification routes(s) of exposure to the environment (to water, air, solid waste and/or soil); and
- patterns of exposure (i.e. accidental/infrequent, occasional, and/or continuous/frequent).

From Box 2.2 it is noteworthy that Section 3 of Annex VI sets out the information that must be provided on the manufacture and use of substances, throughout the supply chain, and including quantities and composition of waste. The classification and labelling information required under Section 4 may be based on available information only. Section 5 requires information on safe use to be included within the technical dossier, separately from any such information in the seperate CSR, and also contains provisions for additional safe use information where a CSR is not required. Furthermore, even though a CSA is not required for 1 to 10 tonne substances, a limited amount of exposure information is required by Section 6.

3.2.3 Article 12 Requirements

Under Article 12(1), the technical dossier submitted for any substance registered at between 1 to 10 tonnes "*shall include … all physicochemical, toxicological and ecotoxicological information that is relevant and available to the registrant*", with Article 12(1)(a) and (b) then setting out the requirements for substances that do and do not meet the Annex III Criteria.

Article 12(1) of REACH states:

> *(a) the information specified in Annex VII for non-phase-in substances, and for phase-in substances meeting one or both of the criteria specified in Annex III, manufactured or imported in quantities of one tonne or more per year per manufacturer or importer[4];*
>
> *(b) the information on physicochemical properties specified in Annex VII, section 7 for phase-in substances manufactured or imported in quantities of one tonne or more per year per manufacturer or importer which do not meet either of the criteria specified in Annex III;*

Annex III referenced in Article 12 states: *Criteria for substances registered between 1 and 10 tonnes, with reference to Article 12(1)(a) and (b):*

> *(a) substances for which it is predicted (i.e. by the application of (Q)SARs or other evidence) that they are likely to meet the criteria for category 1A or 1B classification in the hazard classes carcinogenicity, germ cell mutagenicity or reproductive toxicity or the criteria in Annex XIII;*
>
> *(b) substances:*
>
> *(i) with dispersive or diffuse use(s) particularly where such substances are used in consumer mixtures or incorporated into consumer articles; and*
>
> *(ii) for which it is predicted (i.e. by application of (Q)SARs or other evidence) that they are likely to meet the classification criteria for any health or*

[4] Justification for this distinction between non-phase-in and phase-in substances is not provided in the legal text of REACH.

environmental hazard classes or differentiations under Regulation (EC) No 1272/2008.

From the above, it is clear that for the registration of 1 to 10 tonne substances there are specific minimum information requirements for:

- Phase-in substances that do not meet the criteria set out in Annex III; and
- All other substances (phase-in or non-phase-in).

Adaptations to the information requirements in Annex VII are set out in column 2 of that annex and further adaptations are set out in Annex XI. Annex XI adaptations apply where testing does not appear scientifically necessary or where testing is not technically possible, as summarised in Box 2.3. The application of the adaptations in column 2 of Annex VII and Annex XI must be justified.

Box 2.3: Annex XI Adaptations to Testing Requirements Applicable to 1 to 10 Tonne Substances

Annex XI includes provisions for where:

1. Testing Does Not Appear Scientifically Necessary

1.1. Use of existing data

1.1.1. Data on physical-chemical properties from experiments not carried out according to GLP or the test methods referred to in Article 13(3).

1.1.2. Data on human health and environmental properties from experiments not carried out according to GLP or the test methods referred to in Article 13(3)

1.1.3. Historical human data.

1.2. Weight of evidence

1.3. Qualitative or Quantitative structure-activity relationship ((Q)SAR)

1.4. In vitro methods

1.5. Grouping of substances and read-across approaches.

2. Testing is Technically not Possible

Testing for a specific endpoint may be omitted if it is technically not possible to conduct the study as a consequence of the properties of the substance (e.g. for very volatile, highly reactive or unstable substances, mixing of the substance with water may cause danger of fire or explosion or the radio-labelling of the substance required for certain studies may not be technically possible. The guidance given in the test methods referred to in Article 13(3), more specifically on the technical limitations of a specific method, shall always be respected

Further guidance on how to meet these information requirements is set out in guidance published by ECHA (ECHA, undated). Furthermore, additional guidance on the application of adaptation to information requirements in REACH (including those set out in column 2 of Annex VII and Annex XI) is provided in the guidance published by ECHA.

Adaptations to the data requirements for 1 to 10 substances are considered in more detail in Section 4.

3.2.4 Phase-in Substances that Do Not Meet the Annex III Criteria

Annex VII Requirements

As noted above, under Article 12(1) the technical dossier submitted for any substance registered at between 1 to 10 tonnes "*shall include … all physicochemical, toxicological and ecotoxicological information that is relevant and available to the registrant*".

Under Article 12(1)(b), the information requirements for 1 to 10 tonne substances that do not meet the Annex III criteria are limited to consideration of the physicochemical properties specified in Annex VII, as set out in Table 3.1.

Table 3.1: Information Requirements (Phase-in Substances Not Meeting Annex III Criteria)

Physicochemical Endpoints	**Adaptations to Requirements**[1]
7.1 Physical state of substance (at 20 °C and 101.3 kPa)	None specified
7.2 Melting/ freezing point	Only above -20 °C
7.3 Boiling point	Not required for gases or for solids that melt above 300 °C or any substance which decomposes before boiling. Boiling point at reduced pressure may be used
7.4 Relative density	Where the substance is only stable in solution in a particular solvent and the solution density is similar to that of the solvent, an indication of whether the solution density is higher or lower than the solvent density is sufficient. For gases, an estimation is required based on molecular weight and the Ideal Gas Laws
7.5 Vapour pressure	Not required for solids that melt above 300 °C (if between 200 °C and 300 °C, a limit value based on measurement or a recognised calculation method is sufficient)
7.6 Surface tension	Not required where water solubility is below 1 mg/l at 20 °C, otherwise only when: • based on structure, surface activity is expected or can be predicted; or • surface activity is a desired property of the material
7.7 Water solubility	Not required if hydrolytically unstable at pH 4.7 and 9 (half-life < 12 hours) or readily oxidises in water. Insoluble substances require a limit test up to the analytical detection limit
7.8 Partition coefficient (at least n-octanol/ water ratio)	Not required for inorganic substances. Calculated log P may be provided where direct measurement cannot be performed
7.9 Flash-point	Not required for inorganic substances, or where: • the substance only contains volatile organic components with flash-points above 100 °C for aqueous solutions, or • the estimated flash-point is above 200 °C, or • the flash-point can be accurately predicted by interpolation from existing characterised materials

Table 3.1: Information Requirements (Phase-in Substances Not Meeting Annex III Criteria)	
Physicochemical Endpoints	**Adaptations to Requirements[1]**
7.10 Flammability	Not required for solids that are explosive, pyrophoric or spontaneously ignite when in contact with air. Also not for gases if the concentration of the flammable gas in a mixture with inert gases is so low that, when mixed with air, the concentration is all times below the lower limit or for substances which spontaneously ignite in contact with air
7.11 Explosive properties	Not required where: • there are no chemical groups associated with explosive properties present in the molecule; • the substance contains chemical groups associated with explosive properties which include oxygen and the calculated oxygen balance is less than -200; • an organic substance or a homogenous mixture of organic substances contains chemical groups associated with explosive properties but the exothermic decomposition energy is less than 500 J/g and the onset of exothermic decomposition is below 500 °C; or • a mixture of inorganic oxidising substances (UN Division 5.1) with organic materials, the concentration of the inorganic oxidising substance is: less than 15 %, by mass if assigned to UN Packaging Group I (high hazard) or II (medium hazard); or less than 30 %, by mass if assigned to UN Packaging Group III (low hazard). Neither a test for propagation of detonation, nor a test for sensitivity to detonative shock, is required if the exothermic decomposition energy of organic materials is less than 800 J/g
7.12 Self-ignition temperature	Not required where: • the substance is explosive or ignites spontaneously with air at room temperature; • a liquid is non-flammable in air, e.g. no flash point up to 200 °C • a gas has no flammable range; or • a solid has a melting point ≤ 160 °C, or if preliminary results exclude self-heating of the substance up to 400 °C
7.13 Oxidising properties	Not required where the substance is: • explosive; • highly flammable; • an organic peroxide; • is incapable of reacting exothermically with combustible materials, for example on the basis of the chemical structure; or • a solid if the preliminary test clearly indicates that the test substance has oxidising properties. Note that as there is no test method to determine the oxidising properties of gaseous mixtures, the evaluation of these properties must be realised by an estimation method based on the comparison of the oxidising potential of gases in a mixture with that of the oxidising potential of oxygen in air
7.14 Granulometry	Only for substances marketed in solid or granular form
Note 1: Where these conditions are met, the registrant must clearly state this fact and the reasons justifying this statement	

The ECHA guidance (ECHA, undated) directs registrants to a wide range of published collections of physicochemical data, peer reviewed and non-peer reviewed sources. The point is made that any given data source may not include all of the physicochemical data required to fulfil the Annex VII data requirements and more

than one source may need to be accessed. Caution is also advised when non-peer reviewed data are cited, as the reliability of such data is not certain.

Where data are not available for use in registration of the substance, ECHA (undated) also provides references to a range of freely- or commercially-available computer-based calculation models that can be used to predict the physicochemical properties of substances. These models utilise Quantitative Structure Property Relationships[5] (QSPRs) to make their predictions. The principle features are summarised for each of the model listed, including the physicochemical endpoints estimated and the model's reliability and limitations. Further information on the available models is provided by the ECETOC Technical Report No. 89 (ECETOC, 2003) and the explanatory material that accompanies each model. It is important to note that the models described are extensive but not exhaustive and the models may have been developed further and/or new models developed since the drafting of the guidance.

3.2.5 Other 1 to 10 Tonne Substances

In addition to the information requirements set out above for those 1 to 10 tonne phase-in substances that do not meet the criteria of Annex III (Table 2.1), under Article 12(1)(a) all other 1 to 10 tonne substances require the Annex VII information summarised in Table 3.2.

Persistence, Bioaccumulation and Toxicity

The criteria for identifying substances as being Persistent, Bioaccumulative and Toxic (PBT) and/or as being very Persistent and very Bioaccumulative (vPvB) are set out in Annex XIII to REACH. The identification and assessment of these properties are required as part of a Chemical Safety Assessment (CSA) as set out in Article 14. It is important to note that a CSA is not required for 1 to 10 tonne substances.

The other reference to PBT and vPvB properties is in respect to their communication in the supply chain via SDS (Article 31 and Annex II). The SDS provisions of REACH do apply to 1 to 10 tonne substances but do not require an assessment for PBT/vPvB properties to be carried out.

[5] The more common expression Quantitative Structure Activity Relationship (QSAR) is generally used for models that predict biological/toxicological effects rather than the physicochemical properties of interest here.

Table 3.2: Information Requirements (Not Phase-in or Phase-in Meeting Annex III Criteria)		
Endpoints	**Refinement of Requirements**	**Adaptations to Requirements[1]**
Physicochemical Endpoints		
None		
Human Health Endpoints (Mammalian Toxicology)		
8.1 Skin irritation /skin corrosion	Following consecutive steps: (1) an assessment of the available human and animal data; (2) an assessment of the acid or alkaline reserve; (3) *in vitro* study for skin corrosion; and (4) *in vitro* study for skin irritation	Steps 3 and 4 is not need where: • 1) and 2) indicates classification as corrosive to the skin or irritating to eyes; • the substance is flammable in air at room temperature[2]; • the substance is classified as very toxic in contact with skin; or • an acute toxicity study by the dermal route does not indicate skin irritation up to the limit dose level
8.2 Eye irritation	Following consecutive steps: (1) an assessment of the available human and animal data; (2) an assessment of the acid or alkaline reserve; and (3) *in vitro* study for eye irritation	Step 3 is not need where: • 1) and 2) indicates classification as corrosive to the skin or irritating to eyes[3]; or • the substance is flammable in air at room temperature[2]
8.3 Skin sensitisation	Following consecutive steps: (1) an assessment of the available human, animal and alternative data; and (2) *In vivo* testing (The Murine Local Lymph Node Assay (LLNA) is the first-choice method for *in vivo* testing	Step 2 is not need where: • (1) the available information indicates classification for skin sensitisation or corrosivity; • (2) the substance is a strong acid (pH $\leq$ 2,0) or base (pH $\geq$ 11,5); or • the substance is flammable in air at room temperature[2]
8.4 Mutagenicity	8.4.1. *In vitro* gene mutation study in bacteria	Further testing would be considered following a positive result
8.5 Acute toxicity	8.5.1. By oral route	Not required where: • the substance is classified as corrosive to the skin; or • a study on acute toxicity by the inhalation route (8.5.2) is available (requirement for 10 to 100 tonne substances)
Environmental Endpoints (Ecotoxicology)		

Table 3.2: Information Requirements (Not Phase-in or Phase-in Meeting Annex III Criteria)		
Endpoints	**Refinement of Requirements**	**Adaptations to Requirements[1]**
9.1 Aquatic toxicity	9.1.1. Short-term toxicity testing on invertebrates (preferred species Daphnia)	9.1.1. Not required where: • there are mitigating factors indicating that aquatic toxicity is unlikely to occur, e.g. substance is highly insoluble in water or the substance is unlikely to cross biological membranes4; • a long-term aquatic toxicity study on invertebrates is available; or • adequate information for environmental classification and labelling is available. Long-term toxicity testing may be considered instead of 9.1.1. The long-term aquatic toxicity study on Daphnia (Annex IX, section 9.1.5) is considered if the substance is poorly water soluble
	9.1.2. Growth inhibition study aquatic plants (algae preferred)	9.1.2. Not required where there are mitigating factors indicating that aquatic toxicity is unlikely to occur e.g. substance is highly insoluble in water or the substance is unlikely to cross biological membranes
9.2 Degradation	9.2.1 Biotic/ 9.2.1.1. Ready biodegradability	Not required for inorganic substances
Notes. 1. Where these conditions are met, the registrant must clearly state this fact and the reasons justifying this statement. 2. ECHA (undated) states that this should refer to a substance that is "spontaneously flammable in air at room temperature"). 3. No link is made between a positive identification of skin irritation and potential eye irritation either in the legislation or in ECHA (undated). 4. No further criteria for determining this requirement are provided in the REACH Regulation or ECHA (undated)		

Hazard and Risk Assessment

Where 1 to 10 tonne substances are classified under CLP or have identified PBT/vPvB properties, registrants are required to communicate that information and available hazard data in the supply chain via an SDS, as well as relevant risk management measures to protect health and the environment. However, registrants of 1 to 10 tonne substances are not required to undertake a hazard, exposure or risk assessment. Therefore, the hazard/risk assessment[6] information in an SDS is to be taken from information that is applicable and available. There is no requirement to generate information purely for the purposes of populating a SDS, however, companies may choose to generate such information outside of the requirements of REACH. Information on safe use, required under Annex VI, would also contribute to

[6] As opposed to the hazard information that is in the registration dossier, which must be collated and submitted (with the exception of PBT/vPvB screening).

the advice on safe handling practices and the description of the necessary risk management measures that must be included in a SDS under REACH.

3.3 Consideration of the Use of Non-test Information

It is possible that some or all of the information requirements for 1 to 10 tonne substances may be met through the use of non-test methods, including (Q)SARs and read-across methods. These considerations are addressed, together with the applicability of such methods for meeting the information requirements for 10 to 100 tonne substances in Section 4.

Information generated to fulfil the requirements of EU legislation other than REACH may also be used to meet the information requirements for 1 to 10 tonne substances. Furthermore, there is an expectation that information generated under REACH would inform the application of other EU legislation (for example see Recital 14). An assessment of such interactions between REACH and other EU legislation is described in Section 9 (with more details provided in Annex 1).

4. POSSIBLE CHANGES TO INFORMATION REQUIREMENTS

4.1 Overview

Given the aims of this study, it is necessary to consider the impacts of possible modifications to the current information requirements for 1 to 10 tonne substances. This includes both extension of the obligation to perform a chemical safety assessment and to document it in a chemical safety report. This review is to take into account "all relevant factors", including the costs for manufacturers and importers of drawing up the chemical safety reports, the distribution of costs between actors in the supply chain, and the benefits for human health and the environment (Article 138).

It is important to note that the review required under Article 138 of REACH is specifically focused on substances which are manufactured or imported and thus registered **only** in quantities of less than 10 tonnes per year. However, any changes in the information requirements for such substances will also affect the broader group of registrants who manufacture/import substances at 1 to 10 tonnes, but where the same substance is also registered by others in higher tonnage bands. Here the benefits of higher information requirements would be reduced, although this set of registrants would face increased costs.

4.2 An Upper Bound to Extensions

4.2.1 Basis for the Upper Bound

For the purposes of this study, an upper bound for the extension of possible information requirements has been set at the current provisions for substances manufactured or imported in quantities of 10 tonnes or more but less than 100 tonnes per year per manufacturer or importer (10 to 100 tonne substances). This upper bound may be split naturally between two distinct elements: additional information requirements and the addition of a requirement for risk assessment, as set out below.

- The information requirements set out in Annex VIII (currently only for substances registered in quantities greater than 10 tonnes and less than 100 tonnes per year per registrant.

- A requirement to conduct a Chemical Safety Assessment (CSA), documented in a Chemical Safety Report (CSR). It is assumed that this would include the additional requirement to produce an extended Safety Data Sheet (eSDS).

Further refinement could involve the setting of 'trigger' criteria that would need to be met before these additions would be required (e.g. the criteria set out in Annex III to REACH) or could involve the addition of some but not all of the requirements of approaches 1 or 2 above.

Before approaches 1 or 2 can be assessed, it is necessary to understand the nature of the existing requirements for 10 to 100 tonne substances and CSAs.

4.2.2 Information Requirements for 10 to 100 Tonne Substances

The information requirements for 10 to 100 tonne substances are specified in Annex VII and Annex VIII. Annex VII has been considered in relation to 1 to 10 tonne substances (See Section 2) and it is only the additional requirements from Annex VIII that are presented here in Table 4.1, overleaf.

Table 4.1: Information Requirements from Annex VIII

Endpoints	**Refinement of Requirements**	**Adaptations to Requirements[1]**
Physicochemical Endpoints		
No additional endpoints	None	No additional adaptations
Human Health Endpoints (Mammalian Toxicology)		
8.1 Skin irritation / skin corrosion	8.1.1. *In vivo* skin irritation	8.1.1 not required where: • the substance is classified as corrosive to the skin or as a skin irritant; • the substance is a strong acid (pH ≤ 2,0) or base (pH ≥ 11,5); • the substance is flammable in air at room temperature[2]; • the substance is classified as very toxic in contact with skin; or • an acute toxicity study by the dermal route does not indicate skin irritation up to the limit dose level (2 000 mg/kg body weight)
8.2 Eye irritation	8.2.1. *In vivo* eye irritation	8.2.1 not required where: • the substance is classified as irritating to eyes with risk of serious damage to eyes; • the substance is classified as corrosive to the skin and provided that the registrant classified the substance as eye irritant[3]; • the substance is a strong acid (pH ≤ 2,0) or base (pH ≥ 11,5); or • the substance is flammable in air at room temperature[2]
8.4 Mutagenicity	8.4.2. *In vitro* cytogenicity study in mammalian cells or *in vitro* micronucleus study	8.4.2 not required where: • adequate data from an in vivo cytogenicity test are available, or • the substance is known to be carcinogenic category 1A or 1B or germ cell mutagenic category 1A, 1B or 2
	8.4.3. *In vitro* gene mutation study in mammalian cells	8.4.3 only required following a negative result in Annex VII (8.4.1.) and Annex VIII (8.4.2.). Not needed where adequate data from a reliable *in vivo* mammalian gene mutation test are available
	Note for 8.4: Appropriate *in vivo* mutagenicity studies shall be considered in case of a positive result in any of the genotoxicity studies in Annex VII or VIII	

Table 4.1: Information Requirements from Annex VIII		
Endpoints	**Refinement of Requirements**	**Adaptations to Requirements**[1]
8.5 Acute toxicity	8.5.2. By inhalation	8.5.2. only required where exposure of humans via inhalation is likely taking into account the vapour pressure of the substance and/or the possibility of exposure to aerosols, particles or droplets of an inhalable size
	8.5.3. By dermal route	8.5.3 only required where: • inhalation of the substance is unlikely; • skin contact in production and/or use is likely; and • the physicochemical and toxicological properties suggest potential for a significant rate of absorption through the skin
	8.5. The study/ies do(es) not generally required were the substance is classified as corrosive to the skin. In addition to the oral route (8.5.1), for substances other than gases, the information mentioned under 8.5.2 to 8.5.3 shall be provided for at least one other route. The choice for the second route will depend on the nature of the substance and the likely route of human exposure. If there is only one route of exposure, information for only that route need be provided	

Table 4.1: Information Requirements from Annex VIII		
Endpoints	**Refinement of Requirements**	**Adaptations to Requirements**[1]
8.6. Repeated dose toxicity	8.6.1. Short-term repeated dose toxicity study (28 days), one species, male and female, most appropriate route of administration, having regard to the likely route of human exposure. The **dermal route** is appropriate where: (1) skin contact in production and/or use is likely; (2) the physicochemical properties suggest a significant rate of absorption through the skin; **and** (3) one of the following conditions is met: • toxicity is observed in the acute dermal toxicity test at lower doses than in the oral toxicity test; • systemic effects or other evidence of absorption is observed in skin and/or eye irritation studies; • in vitro tests indicate significant dermal absorption; or • significant dermal toxicity or dermal penetration is recognised for structurally-related substances. The **inhalation route** is appropriate where: • exposure of humans via inhalation is likely taking into account the vapour pressure of the substance and/or the possibility of exposure to aerosols, particles or droplets of an inhalable size	8.6.1 not required where: • a reliable sub-chronic (90 days) or chronic toxicity study is available, provided that an appropriate species, dosage, solvent and route of administration were used; • a substance undergoes immediate disintegration and there are sufficient data on the cleavage products; or • relevant human exposure can be excluded in accordance with Annex XI Section 3. **Further studies** shall be proposed by the registrant or may be required by ECHA in cases of: • failure to identify a NOAEL in the 90 days study unless the reason is absence of adverse toxic effects; • toxicity of particular concern (e.g. serious/severe effects); • indications of an effect for which the available evidence is inadequate for toxicological and/or risk characterisation. In such cases it may also be more appropriate to perform specific toxicological studies that are designed to investigate these effects (e.g. immunotoxicity, neurotoxicity); or • particular concern regarding exposure (e.g. use in consumer products leading to exposure levels which are close to the dose levels at which toxicity to humans may be expected)

Table 4.1: Information Requirements from Annex VIII		
Endpoints	**Refinement of Requirements**	**Adaptations to Requirements**[1]
8.7 Reproductive toxicity	8.7.1.Screening for reproductive/ developmental toxicity, one species (OECD 421 or 422), if there is no evidence from available information on structurally related substances, from (Q)SAR estimates or from in vitro methods that the substance may be a developmental toxicant	8.7.1 not required if the substance is: • known to be a genotoxic carcinogen and appropriate risk management measures are implemented; • known to be a germ cell mutagen and appropriate risk management measures are implemented; • relevant human exposure can be excluded in accordance with Annex XI section 3; or • a pre-natal developmental toxicity study (Annex IX, 8.7.2) or a two-generation reproductive toxicity study (Annex IX, Section 8.7.3) is available. If a substance is known to have an adverse effect on fertility, meeting the criteria for classification as toxic for reproduction category 1A or 1B: May damage fertility (H360F), and the available data are adequate to support a robust risk assessment, then no further testing for fertility will be necessary. However, testing for developmental toxicity must be considered. If a substance is known to cause developmental toxicity, meeting the criteria for classification as toxic for reproduction category 1A or 1B: May damage the unborn child (H360D), and the available data are adequate to support a robust risk assessment, then no further testing for developmental toxicity will be necessary. However, testing for effects on fertility must be considered. In cases where there are serious concerns about the potential for adverse effects on fertility or development, either a pre-natal developmental toxicity study (Annex IX, Section 8.7.2) or a two-generation reproductive toxicity study (Annex IX, Section 8.7.3) may be proposed by the registrant instead of the screening study
8.8 Toxico-kinetics	8.8.1. Assessment of the toxicokinetic behaviour of the substance to the extent that can be derived from the relevant available information Results from OSIRIS encourage the notion that further development of integrated physiologically based pharmacokinetic (PBPK) models, and the assays for *in vitro* data inputs, will provide a means to predict reliably toxicokinetics for a wide range of REACH-relevant compounds.	

Table 4.1: Information Requirements from Annex VIII		
Endpoints	**Refinement of Requirements**	**Adaptations to Requirements[1]**
Environmental Endpoints (Ecotoxicology)		
9.1 Aquatic toxicity	9.1.3. Short-term toxicity testing on fish (or long term study, if preferred)	9.1.3. Not required where: • there are mitigating factors indicating that aquatic toxicity is unlikely to occur; or • a long-term aquatic toxicity study on fish is available. Long-term aquatic toxicity testing as described in Annex IX shall be considered if the CSA indicates the need to investigate further effects on aquatic organisms. The choice of the appropriate test(s) will depend on the results of the CSA. The long-term aquatic toxicity study on fish (9.1.6) shall be considered if the substance is poorly water soluble
	9.1.4. Activated sludge respiration inhibition testing	9.1.4. Not required where: • no emission to a sewage treatment plant; or • there are mitigating factors indicating that microbial toxicity is unlikely to occur; • the substance is found to be readily biodegradable and the applied test concentrations are in the range of concentrations that can be expected in the influent of a sewage treatment plant. 9.1.4. may be replaced by a nitrification inhibition test if available data show that the substance is likely to be an inhibitor of microbial growth or function, in particular nitrifying bacteria
9.2. Degradation	9.2.2. Abiotic: 9.2.2.1. Hydrolysis as a function of pH	9.2.2.1 Not required where the substance is: • readily biodegradable; or • highly insoluble in water
	Further degradation testing to be considered if the CSA indicates the need to investigate further. The choice of the appropriate test(s) will depend on the results of the CSA	
9.3. Fate and behaviour in the environment	9.3.1. Adsorption/desorption screening	9.3.1. Not required where: • a low potential for adsorption is expected based on the physicochemical properties (e.g. from octanol-water partition coefficient); or • the substance and its relevant degradation products decompose rapidly
Notes. 1. Where these conditions are met, the registrant must clearly state this fact and the reasons justifying this statement. 2. ECHA (undated) states that this should refer to a substance that is "spontaneously flammable in air at room temperature"). 3. No link is made between a positive identification of skin irritation and potential eye irritation either in the legislation or in ECHA (undated)		

4.2.3 Chemical Safety Assessment and Report

In general, a CSA must be carried out for 10 to 100 tonne substances, as specified in Article 14 of REACH and detailed in Annex I. Further details of the requirements for PBT/vPvB assessment are set out in Annex XIII. The preparation of the CSA is likely to be an iterative process, with the amount of work required to complete a CSA depending upon the number of iterations required. The information in the CSA must be documented in a Chemical Safety Report (CSR) and communicated in the supply chain via SDS. Further non-binding guidance on the preparation of a CSA and a CSR is provided in ECHA (undated).

Hazard Assessment

The first stage of a hazard assessment (HA) is the gathering of information to meet the tonnage dependent information requirements discussed earlier. The available information is then evaluated for:

- **Relevance** for hazard identification or risk characterisation.
- **Reliability** for use in hazard and risk assessment. Use of the Klimishch scoring system is recommended.
- **Adequacy** for hazard and risk assessment (includes assessment of available test data, non-test data (includes (Q)SARs, read-across and grouping approaches) and human data (includes analytical, descriptive and correlational epidemiology plus case reports and controlled studies on human volunteers).

The HA process involves a weight of evidence approach that requires expert judgement.

Persistence, Bioaccumulation and Toxicity

The identification and assessment of PBT/vPvB properties are required as part of a CSA and these properties need to be documented in both the Chemical Safety Report (CSR) and any SDS supplied with the substance.

The criteria for identifying substances as being Persistent, Bioaccumulative and Toxic (PBT) and/or as being very Persistent and very Bioaccumulative (vPvB) are set out in Annex XIII to REACH and summarised in Table 4.2.

The information required under Annexes VII and VIII (plus other available information) should be used to screen a substance against the PBT/vPvB screening data set out in Section 3.1 of Annex XIII and summarised in Table 4.3 below.

Table 4.2: Criteria for PBT or vPvB from Annex XIII			
	Persistence (degradation half life (days))	**Bioaccumulation**	**Toxicity**
PBT	• marine water > 60; • estuarine water > 40; • marine sediment > 180; • estuarine sediment > 120; or • soil > 120	Bioconcentration factor in aquatic species is higher than 2,000 L/kg	• long-term (NOEC) or EC10 for marine or freshwater organisms < 0,01 mg/l; • meets CLP criteria for: • Carc./ Mut. Cat. 1A; 1B; • Repr. Cat. 1A, 1B or 2; or • specific target organ toxicity after repeated exposure (STOT RE category 1 or 2)
vPvB	• arine, fresh or estuarine water > 60; • arine, fresh or estuarine water sediment > 180; or • oil > 180	Bioconcentration factor in aquatic species is higher than 5,000 L/kg	N/A

Table 4.3: PBT/vPvB Screening Criteria from Annex XIII			
Property	**Screening Data**	**Assessment with Min. Data from:**	
		Annex VII	**Annex VIII**
P or vP	Ready biodegradation (test 9.2.1.1)[1]	Y	-
	Other screening tests (e.g. enhanced ready test, tests on inherent biodegradability)	N	Abiotic hydrolysis (9.2.2.1 only)
	Estimated by biodegradation (Q)SAR models in accordance with Section 1.3 of Annex XI[2]	?	?
	Other information provided that its suitability and reliability can be reasonably demonstrated	N	N
B or vB	Octanol-water partitioning coefficient experimentally determined	Y	-
	estimated by (Q)SAR models in accordance with Section 1.3 of Annex XI	?	?
	Other information provided that its suitability and reliability can be reasonably demonstrated	N	N
T	(a) Short-term aquatic toxicity (test 9.1.3)	N	Y
	(b) Other information provided that its suitability and reliability can be reasonably demonstrated	If CMR or STOT RE	If CMR or STOT RE
Notes. 1. ECHA (undated) but not the legislation states that valid QSARs may be used to predict acute toxicity. 2. ECHA (undated) recommends Biowin 2 (non-linear model prediction) and Biowin 3 (ultimate biodegradation time) or Biowin 6 (MITI non-linear model prediction)			

If the criteria for **persistence** are met, then ECHA (undated) recommends that an assessment of likely exposure receptors is carried out before undertaking any testing, which should be targeted at identified receptors only, as summarised in Table 4.4.

Table 4.4: Possible Additional Testing for Persistence		
Exposure Identified to Receptor	**Test**	**Comment**
Soil	Transformation in soil test (OECD 307)	-
Coastal water	Marine water and/or water/sediment test (OECD 308/309 aerobic only)	-
Estuarine water	Brackish water/sediment test (OECD 308/309 aerobic only)	Not needed if assessed for coastal water
Fresh water	Surface water and/or water/sediment test (OECD 308/309 aerobic only	Not needed if assessed for coastal or estuarine water
Potential for long rang transport	Oceanic water die-away test (OECD 309)	-

If a 10 to 100 tonne substance matches the screening criteria for **bioaccumulation**, then ECHA (undated) indicates that bioconcentration factor (BCF) testing may be required and recommends the OECD 305 test. However, a weight of evidence assessment should be undertaken first to attempt to justify that a substance does not meet the criteria for bioaccumulation properties. Furthermore, to avoid unnecessary animal testing, such testing should only be undertaken where it is clear that the substance meets the criteria for the identification of persistent properties.

ECHA (undated) indicates that additional chronic toxicity testing should first be carried out on non-vertebrate species, unless there are indications that fish is the most sensitive group and that it is entirely the responsibility of the registrant to rank the sensitivities. However, chronic toxicity testing should not be undertaken where:

- the substance is classified or likely to be classified under CLP as Carcinogenic Cat. 1A or 1B;
- the substance is classified or likely to be classified under CLP as a Germ Cell Mutagen Cat. 1A or 1B;
- the substance is classified or likely to be classified under CLP as a being Toxic to Reproduction Cat. 1A, 1B or 2;
- any EC50 is not < 0.1 mg/l from acute aquatic toxicity data, however confirmation that not false negative is necessary and chronic testing may still be needed; or
- P or B assessments are negative.

Annex XIII states that no additional information needs to be generated for the assessment of PBT/vPvB properties if there is no indication of P or B properties following the result from the screening test or other information.

Exposure Assessment

An exposure assessment (EA) is required as part of a CSA where the HA identifies:

- PBT or vPvB properties; or
- classification as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I.

An EA is also required were a registrant chooses to rely upon the exposure based waiving of information requirements under Annex XI, and is required for each application of a substance (see ECHA (undated) Figure D.2-1).

The EA should consider all relevant stages in life-cycle of a substance within the EU, including:

- manufacture;
- formulation;
- industrial use
- professional use;
- consumer use;
- service life of articles;
- waste life stage (not a downstream use under REACH); and
- environmental receptors (fresh and marine surface waters (including sediments), terrestrial ecosystem, top predators via the food chain (secondary poisoning), micro-organisms in sewage treatment systems, atmosphere (primarily where potential for ozone depletion, global warming, ozone formation in the troposphere, or acidification), and human health via the environment).

To determine or predict the level to which human beings or the environment are exposed to a substance, consideration also has to be given to the risk management measures (RMM) used to control exposures.

Risk Characterisation

The next step in the process is risk characterisation, which involves the assessment of hazard and exposure data from the earlier stages of the CSA and the determination of whether the risks posed by a substance are adequately controlled throughout its life-cycle. The level of risk is normally measured in terms of risk characterisation ratios (RCRs) that are determined for all relevant hazard endpoints, receptors, exposure routes and time scales, or through a qualitative assessment for non-threshold endpoints.

The risks from a substance may be considered to be adequately controlled where the RCR <1 (just controlled where RCR =1). Often the exposure data used in the RCR calculation are based on highly precautionary generic estimates for the process being used and the RMM being applied. Where the use of these estimates results in a RCR < 1 there is no need to consider generating more accurate estimates. However, where the RCR is found to be ≥ 1, then more accurate exposure estimates may be made (e.g. based on measured emissions data) and/or the occupational conditions may be more accurately defined (e.g. more restrictive RMM may be required). An iterative process of refinement of exposure estimates may be required until adequate control may be demonstrated via the generation of a RCRs <1 for all uses.

It is important to note that for PBT and vPvB properties it is not possible to predict threshold below which they can be considered to be adequately controlled (i.e. cannot calculate a PNEC). It is not possible therefore to develop RCRs for such substances.

4.3 Reduction of Information Requirements

4.3.1 Potential Models for Reductions

When considering the appropriateness of the current requirements for the registration of 1 to 10 tonne substances, there are three obvious models for the reduction of the information requirements; these are as follows.

- **Minimum reduction:** Allow non-phase-in substances that meet the criteria set out in Annex III to benefit from the reduced information requirements for phase-in substances set out in Article 12(1)b.

- **Mid-level reduction:** Reduce information requirements to those required for isolated intermediates (with or without the requirement for additional testing):
  - For all 1 to 10 tonne substances;
  - For 1 to 10 tonne substances that do not meet the criteria set out in Annex III.

- **Maximum reduction:** Raise the threshold for registration from 1 tonne to 10 tonnes:
  - For all 1 to 10 tonne substances;
  - For 1 to 10 tonne substances that do not meet the criteria set out in Annex III.

As for an extension to information requirements (Section 3), further refinement could include the setting of trigger criteria that would need to be met before these reductions would be allowed or could involve the removal of some but not all of the current requirements for 1 to 10 tonne substances.

Before reductions in the registration requirements can be assessed, it is necessary to understand the nature of the requirements for 1 to 10 tonne substances that do not meet the Annex III criteria, and the requirements for intermediates.

4.3.2 Article 12(1)b Information Requirements

The criteria set out in Annex III and the reduced information requirements, set out in Article 12, are discussed in Section 2.2.4 and are not repeated here for the sake of brevity. However, in summary, the application of Article 12(1)b reduces the information requirements to the physicochemical information set out in Annex VII to REACH for those substances that meet the criteria set out in Annex III.

4.3.3 Information Requirements for Intermediates

Intermediates and Registration

There are three forms of intermediate defined under Article 3 of REACH:

> *intermediate: means a substance that is manufactured for and consumed in or used for chemical processing in order to be transformed into another substance (hereinafter referred to as synthesis):*

(a) ***non-isolated intermediate****: means an intermediate that during synthesis is not intentionally removed (except for sampling) from the equipment in which the synthesis takes place. Such equipment includes the reaction vessel, its ancillary equipment, and any equipment through which the substance(s) pass(es) during a continuous flow or batch process as well as the pipework for transfer from one vessel to another for the purpose of the next reaction step, but it excludes tanks or other vessels in which the substance(s) are stored after the manufacture;*

(b) ***on-site isolated intermediate****: means an intermediate not meeting the criteria of a non-isolated intermediate and where the manufacture of the intermediate and the synthesis of (an)other substance(s) from that intermediate take place on the same site, operated by one or more legal entities;*

(c) ***transported isolated intermediate****: means an intermediate not meeting the criteria of a non-isolated intermediate and transported between or supplied to other sites;*

.....

site: means a single location, in which, if there is more than one manufacturer of (a) substance(s), certain infrastructure and facilities are shared.

Non-isolated intermediates are exempt from the provisions of REACH (Article 2(1)c).

There are reduced registration requirements for both types of isolated intermediate which are dependent on registrants being able to justify that the substance is only manufactured/imported/transported and used under strictly controlled conditions throughout its whole lifecycle as an intermediate.

Article 2 states that both forms of isolated intermediates are exempted from the normal information requirements for registration with the exception of the provisions of Article 8 which allows for the appointment of an Only Representative and Article 9 which provides an exemption from registration for PPORD. Under Article 2, intermediates are also exempted from the provisions for authorisation as set out under Title VII. Furthermore, Article 49 states that neither dossier nor substance evaluation shall apply to **onsite isolated intermediates**, and sets out specific, reduced, evaluation provisions for these substances.

The general information requirements for the registration of **on-site and transported isolated intermediates** are limited to the information set out in Annex VI, namely (Article 17 and Article 18):

- identity of the manufacturer;
- identity of the intermediate;
- classification of the intermediate;

- any available existing information on physicochemical, human health or environmental properties of the intermediate. Where a full study report is available, a study summary shall be submitted;
- a brief general description of the use; and
- details of risk management measures used or recommended.

For on-site isolated intermediates, the information listed above only needs to be provided "*to the extent that the manufacturer is able to submit it without any additional testing*" (Article 17). However, no such limitation is stated for transported isolated intermediates (Article 18). Furthermore, for transported isolated intermediates manufactured and/or imported in quantities greater than 1,000 tonnes per year per registrant, the information requirements are extended to cover those required for the registration of non-intermediate substances in the 1 to 10 tonne per year range, as set out in Annex VII (discussed in Section 3 of this report).

5. INFORMATION FROM SOURCES OTHER THAN ADDITIONAL TESTING

5.1 Introduction

The REACH Regulation stipulates that the principles of Replacement, Reduction and Refinement (3Rs) of the use of animals in procedures should be fully taken into account in the design of test methods, in particular when appropriate validated alternative methods and approaches become available.

As indicated earlier, Annex XI sets out the general rules for adaptation of the standard testing regime specified in Annexes VII to X, via use of the following alternative sources of information:

- weight of evidence;
- existing data;
- the grouping of substances and the read-across approach;
- exposure Based Waiving of testing requirements;
- qualitative or Quantitative Structure-activity Relationships ((Q)SARs); and
- *in vitro* methods in place of *in vivo* methods.

Further assistance on the application of alternative approaches is provided by ECHA (undated), particularly Chapter R5, Chapter R6 on the application of (Q)SARs, and the endpoint specific guidance provided in Chapter R7. Further tools and approaches are also available from other sources, for example, OSIRIS (2012). The information provided here on the assessment of (Q)SARs and *in vitro* methods summarises that recorded in Annex 2.12

5.2 Weight of Evidence

The weight of evidence approach involves the careful weighing of all available information that may contribute to an understanding of the hazard properties of a substance and may be appropriate for cases where data from sources other than tests specifically addressing an endpoint can provide valuable information, as well instances where there exist several studies – each of which are in themselves *inadequate* – for a given endpoint but which together adequately describe the endpoint of concern, such that a further test for that particular endpoint may not be considered unnecessary. In order to be able to justify the adoption of an evidence based approach, it is generally appropriate to assess the relative values/weight that should be applied to the various different pieces of information available, for example by assigning a value to each. This may be achieved using either an objective approach based on a formalized procedure or by drawing on expert judgement.

The value/weight given to each piece of evidence is influenced by factors such as data quality, consistency of results, nature and severity of effects under consideration, and relevance to a given regulatory endpoint. Examples of such approaches include the

use of Klimisch scores to assess the value of toxicity studies, use of the Hill criteria for epidemiological data or the use of ranking systems for concerns such as endocrine potential or ecologic risk (see Chapter 4 of ECHA (undated) for further discussion of such aspects). Through use of expert judgement, it may be possible therefore to determine whether information from sources other than the tests specified in Annexes VII to X may together justify a particular conclusion for a test endpoint. For example, by pooling the evidence from a range of studies that on their own would not be sufficient to determine a NOAEL or classification, it may be possible to set a NOAEL or to determine an appropriate classification without the need for further testing to extend the currently available dataset.

Chapter R5 of ECHA (undated) makes the point that a weight of evidence approach is closely linked to application of Integrated Testing Strategies (ITSs). Indeed, use of ITS is currently a crucial component of the endpoint-specific guidance provided by Chapter R7 of ECHA (undated). These chapters provide guidance on how to define and generate relevant information on substances in order to meet the requirements for REACH. The general flow of data assessment in an ITS is: (1) consideration of existing studies / evidence; (2) application of QSARs; (3) application of *in vitro* methods; (4) weight-of-evidence analysis; and, as a last resort, (5) the proposal of *in vivo* testing. An overview of the application of ITS for the determination of for example skin/eye irritation/corrosion is illustrated in Figure 5.1, which reproduces Figure R.7.2-1 from Chapter R7 of ECHA (undated).

Figure R.7.2-1 Overview of the Integrated Testing Strategy for irritation/corrosion

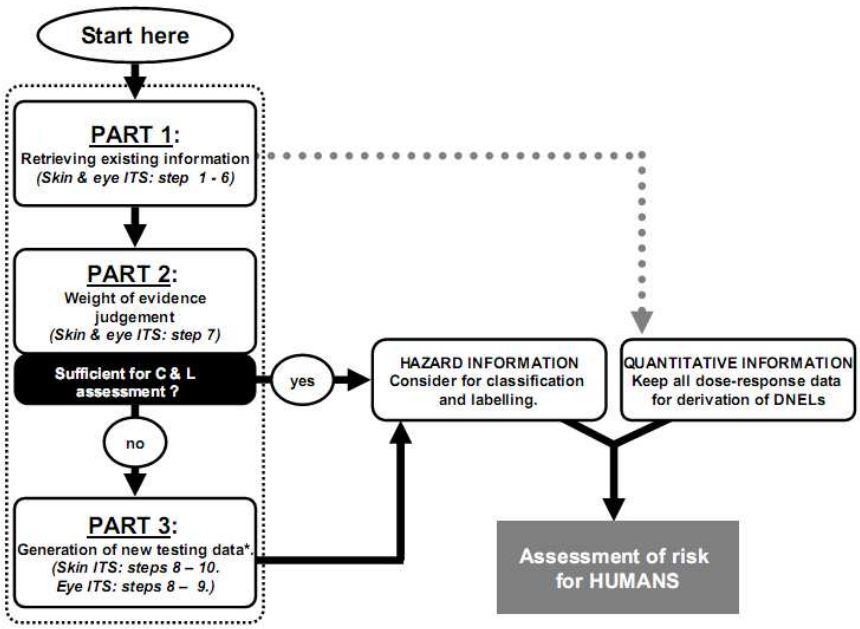

Figure 5.1: Application of ITS to Skin/Eye Irritation/Corrosion (ECHA, undated)

The adoption of an ITS-based approach has recently been facilitated by Pillar 4 (Integration strategies and Tools) of the recently completed 6th Framework Programme project OSIRIS (OSIRIS, 2012) which sought to develop tools

specifically for use within a REACH-scenario to guide the use of non-test information within a regulatory context so as to minimising animal testing needs. Specifically, operational procedures were developed and made freely available to ensure the transparent, scientifically sound evaluation of specific substances. This was achieved through adoption of a decision framework drawing on the use of alternative methods (such as chemical and biological read-across, in vitro data and in vivo information on analogues, together with incorporation of qualitative and quantitative structure-activity relationships, threshold of toxicological concern approaches) as well as exposure-based waiving. This is implemented through use of a downloadable tool (see Figure 5.2) that provides a user-interactive workflow to weights different data types so as to inform decisions regarding data suitability for supporting both classification/labelling and chemical risk assessment. Where data gaps are detected, appropriate test approaches are suggested that may address them. The current OSIRIS project has provided frameworks to support the following important ecotoxicity and toxicity endpoints: aquatic toxicity; bioconcentration factor; carcinogenicity; mutagenicity; repeated dose toxicity and sensitization.

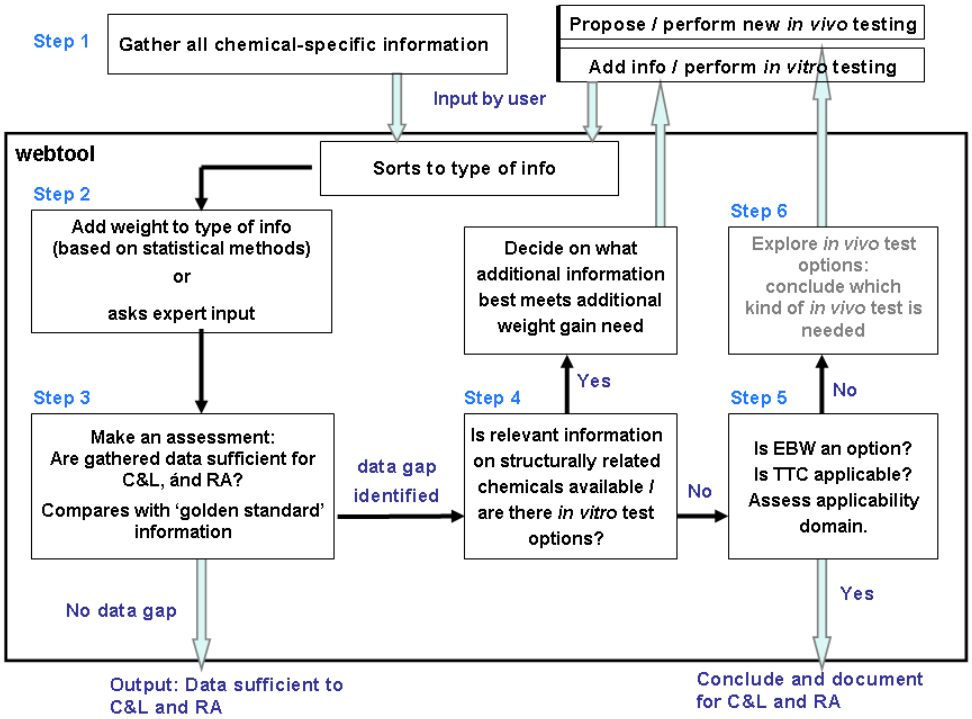

Figure 5.2: Schematic of OSIRIS ITS Tool (OSIRIS, 2012)

When considering the suitability of available information to inform a decision on a particular endpoint, it is therefore important to first consider if the data and any related decisions are consistent with the objective of achieving an adequate degree of hazard characterisation and if they are sufficient to permit the classification of the substance or to inform risk assessment. If so, then no further testing would be recommended. In some instances, there may be scientific grounds for excluding the need for further testing, for example if the weight-of-evidence analysis has demonstrated there to be sufficient information to characterise the nature of any

hazard and to demonstrate that exposures are adequately controlled, or if it is not relevant. For example, this might be a result of its physicochemical properties (e.g. a substance with very low vapour pressure would be unlikely to constitute an inhalation hazard) or the substance may not be bioavailable via a particular route for which the local toxicity potential has been adequately characterised. A conclusion that no further testing is required may be reached when the data meet the requirements for classification or if it is already classified for that endpoint. In some situations, evidence may be available from humans and animal models but show a conflict. In this case, while good quality human data should take precedent over experimental data, the evidence must be evaluated with regard to illuminating the toxicological basis for the divergent findings and the quality and reliability of the datasets should also be considered. Where no clear conclusion emerges, consideration should then be given to seeking additional insight through application of *in vitro*, QSARs or read-across techniques, before considering proposing new *in vivo* experimental studies. Thus before using a weight of evidence approach in place of testing, a robust and clearly documented justification must be developed.

5.3 Existing Data

As indicated in Section 3, registrants are to use all available data in completing his technical dossier. Thus, were a registrant has access to data from a test(s) conducted prior to the introduction of REACH that matches the information requirements for their substance, this information should be used and shared with other members of the Substance Information Exchange Forum (SIEF) for that substance. The sharing of *in vivo* information is mandatory under REACH while the sharing of *in vitro* test information is encouraged but not mandatory for the registration of phase-in substances. However, the sharing of all data becomes mandatory for a previous registrant when a new registrant needs to refer to his data. A suitable payment will be required to the data holder for the provision of this shared information. Furthermore, after 12 years of a registration any study summaries or robust study summaries submitted can be used for the purposes of registration by another manufacturer or importer, without the need to pay the data holder (Article 25(3)).

Furthermore, Annex XI sets out the principles under which non-GLP test information and historic human information may be used to fulfil information requirements for registration, wholly or in part.

5.4 Read-across and Grouping

The terms ‘grouping’ or ‘chemical grouping’ describe the general approach of assessing more than one substance at the same time. It can include formation of a chemical category or identification of a chemical analogue for which read-across may be applied. Read-across is a technique used to predict endpoint information for one substance by using data from the same endpoint from another substance which is considered to be similar in some way (on the basis of structural similarity and similar properties and/or activities).

Many different factors must be taken into account when assessing the scientific rationale for reading-across from one substance to another. Broadly speaking, physicochemical endpoints are substance specific while read-across may be used for many, but not all, environmental and mammalian toxicology endpoints.

Read-across may be qualitative or quantitative. In **qualitative** read-across, the presence (or absence) of a property/activity for the target substance is inferred from the presence (or absence) of the same property/activity for one or more source substances. Qualitative read-across gives a 'yes/no' answer. In quantitative read-across, the known value(s) of a property for one or more source substances is used to estimate the unknown value of the same property for the target substance. **Quantitative** read-across is used to obtain a quantitative value for an endpoint, such as a dose-response relationship.

Read-across is based on and dependent upon the identification of similar substances and it can be performed to determine whether the target substance belongs to an existing category (chemical category) or to identify a similar substance to the target substance (analogue search). There are many freely available tools that may be used for this purpose. However, the main read-across tools currently available are the Analog Identification Methodology (AIM), Danish (Q)SAR database, Toxmatch, and the OECD QSAR Toolbox (2012).

5.5 Data Waiving

5.5.1 Summary

Part 3 of Annex XI deals with substance tailored, exposure driven testing for Sections 8.6 and 8.7 of Annex VIII[7], and Annex IX[8] and Annex X where tests may be omitted (waived) based on the exposure scenario(s) developed in the Chemical Safety Assessment (CSA) and documented in the Chemical Safety Report (CSR). Such waiving needs to be justified based on an exposure assessment in accordance with Section 5 of Annex I. An exposure assessment may be based on data measured or generated specifically for the registration of one substance or it may be based on generic exposure estimates (usually worst case estimates) or broad industry specific estimates (particularly SPecific Environmental Release Categories (SPERCs)) (ECHA (undated), Section D, and Cefic/VCI (2010), Part II).

[7] These sections refer respectively to the short-term repeated dose toxicity study (28 days) and the screening for reproductive/developmental toxicity, one species.

[8] Note that Annex IX paragraph 8.6.1. states that the short-term repeated dose toxicity study (28 days), is required unless already provided as part of the Annex VIII requirements (i.e. not waived) or a 90 day study is proposed. In this case, Section 3 of Annex XI shall not apply.

The essential elements for Exposure Based Waiving (EBW, also known as Exposure Based Assessment (EBA)) are (Annex XI and Chapter R5 of ECHA (undated)) as follows.

- Testing according to Annex VIII (only Sections 8.6 and 8.7), Annex IX and Annex X may be omitted, based on exposure scenario(s) containing information on exposure and implemented risk management measures.
- In all cases, adequate justification and documentation needs to be provided based on an exposure assessment in accordance with Section 5 of Annex I.
- The conditions of use as specified in the Exposure Scenario (ES) must be communicated through the chemical's supply chain via the SDS or otherwise if an SDS is not required.

It is important to note that to justify EBW, an exposure assessment (including development of an exposure scenario) is always required even if the substance is not classified as dangerous or is not a PBT/vPvB.

In any EBW case, all relevant stages in the life-cycle of a chemical should be taken into account for a valid justification of waiving. Therefore, a prerequisite for EBW is the collection and evaluation of available knowledge on the hazards of the substance, conditions of use over the whole life cycle and the identified uses of the substance. In addition, extensive and detailed knowledge of exposure throughout the life cycle for human and environmental exposure is essential. Depending on the type of test that is waived, occupational exposure, consumer exposure and human exposure via the environment, as well as exposure of all environmental compartments, may need to be considered. If exposure can be excluded for a specific use (e.g. no consumer exposure), the relevant stages of the associated life-cycle still need to be considered for exposure to workers or professional users, in order to determine if waiving for a specific endpoint is appropriate.

As a general rule, it may be difficult to justify EBW for a substance with a wide spectrum of uses since it will be difficult to demonstrate that the risks are adequately controlled for all of these uses throughout the life-cycle. However, this may be less of an issue for 1 to 10 tonne substances.

The justification for waiving should be based on information on hazard, exposure and the exposure scenarios (ES) to clearly define the relevant operational conditions and risk management measures. If EBW is supported by an exposure assessment including development of ESs, this needs to be documented in the Chemical Safety Report (CSR).

ECHA (undated) sets out two different ways in which EBW might be justified, qualitative and quantitative.

5.5.2 Qualitative Justification

In relation to the waiving of testing in Annexes VIII-X, the guidance (ECHA, undated) suggests that when human or environmental exposure can be excluded, the

derivation of a DNEL or PNEC for a specific endpoint is not needed since the outcome of the risk assessment can only indicate that there is no significant risk. Annex XI states that a registrant must *demonstrate the absence of or no significant exposure in all* [exposure] *scenarios.*

In practical terms, the guidance suggests that EBW may be applied where a substance is handled under *strictly controlled conditions*, as set out in Article 18(4) of REACH (by definition there can be no consumer exposure and no dispersive use). EBW may also be applied where it can be proven (and documented with suitable evidence) that a substance is permanently bound to a matrix.

5.5.3 Quantitative Justification

For EBW of some endpoints, the available hazard information may allow derivation of threshold levels (a PNEC or DNEL) or reference levels relevant for the specific test being waived. This will allow for a quantitative comparison of the exposure to the no-effect level for the endpoint for which further testing is proposed to be waived.

The guidance states if a threshold level or reference level cannot be derived (e.g. due to the lack of relevant hazard information for the endpoint), it may under certain circumstances be possible to use an accepted toxicological threshold for the endpoints of concern. In cases where no reliable or suitable threshold is available, it will be very difficult to argue on quantitative grounds that further testing for a specific endpoint is not needed.

5.6 SARs and QSARs

REACH specifically promotes the use of (Quantitative) Structure Activity Relationships ((Q)SARs). A SAR is a qualitative relationship that relates a (sub)structure to the presence or absence of a property or activity of interest. The substructure may consist of adjacently bonded atoms or an arrangement of non-bonded atoms that are collectively associated with the property or activity. In contrast, a QSAR is a mathematical model (often a statistical correlation) relating one or more quantitative parameters derived from a chemical structure to a quantitative measure of a property or activity (e.g. a (eco)toxicological endpoint). QSARs are quantitative models yielding continuous or categorical results.

Expert systems, on the other hand, seek to apply rules that encompass existing human knowledge about the links between key complex structural features and particular toxicological end-points. It is now becoming possible to provide automated help with the discovery of rules that are suitable for use in knowledge-based expert systems. Since expert systems are a diverse group of models consisting of combinations of SARs, QSARs and databases, the distinction between (Q)SAR and expert systems cannot always be easily made and, therefore, expert systems are considered under the umbrella term “QSAR” (Chapter R.6 of ECHA, undated).

For a (Q)SAR result to be adequate for a given regulatory purpose, the following conditions must be fulfilled (Chapter R6 of ECHA (undated) and Annex XI(1)(3) to REACH)

1. The estimate should be generated by a valid (relevant and reliable) model.
2. The model should be applicable to the chemical of interest with the necessary level of reliability.
3. The model endpoint should be relevant for the regulatory purpose.

These conditions are illustrated in Figure 5.3 and form the basis for assessment of (Q)SARs during the conduct of this task.

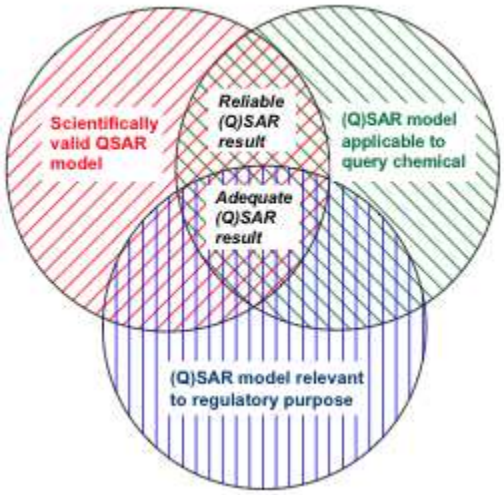

Figure 5.3: Interrelated Concepts of (Q)SAR Validity, Reliability, Applicability, Adequacy and Regulatory Relevance (Figure R6-1, from Chapter 6 of ECHA (undated))

The circles in Figure 5.3 refer to (Q)SAR models whereas the intersections refer to (Q)SAR results with certain features. For a (Q)SAR result to be considered reliable for a given chemical substance, it should be generated by a scientifically valid (Q)SAR model that is also applicable to the substance of interest. This (Q)SAR estimate may or may not be adequate (fit for purpose) depending on whether the endpoint predicted is relevant to the particular regulatory purpose (in this case, the REACH information requirements for 1 to 10 t/y for the purpose of classification and/or risk assessment), and whether the estimate is sufficiently reliable for that purpose.

5.7 QSAR Performance Applicable to 1 to 10 Tonne Substances

In the impact assessment undertaken for the Commission in 2006 by RPA (RPA, 2006), the extent to which a QSAR was likely to provide a substitute for actual testing was taken to be a function of performance and domain, which were at that time qualitatively defined by expert judgment as:

- performance: under/over predictions or relative number of false negatives/false positives plus overall concordance; and
- domain of model (i.e. how many chemicals of those considered can reliably be predicted compared to how many chemicals this is not possible for).

The overall RPA assessment in 2006 assigned scores of POOR, FAIR and GOOD and was mainly based on expert judgement without a detailed justification/reference.

Moving forward from 2006, the internationally-agreed OECD principles for the validation of a (Q)SAR and use of a (Q)SAR for regulatory purposes were taken into consideration for the assessment of (Q)SAR quality and relevance[9]. The five OECD principles are endorsed in the ECHA guidance on information requirements (ECHA, undated[10]). Therefore, the extent to which (Q)SARs meet these five OECD principles has been used to indicate current regulatory acceptance over the timeframes indicated. Future regulatory acceptance has been assessed by expert prediction of the likely agreement with the five OECD principles by 2018. These principles can be summarised as follows, where every (Q)SAR should have:

- **a defined endpoint**: where endpoint refers to any physicochemical property, biological effect (human health or ecological) or environmental fate parameter that can be measured and therefore modelled;

- **an unambiguous algorithm**: The intent of this principle is to ensure transparency in the description of the model algorithm;

- **a defined domain of applicability**: The domain of applicability specifies a group of molecular structures for which the model is applicable. For molecule structures outside of this domain the model is not applicable. (Q)SAR model predictions are most reliable if they come from the model's applicability domain;

- **appropriate measures of goodness-of-fit, robustness and predictivity**: This principle expresses the need to assess two types of information: a) the internal performance of a model (as represented by goodness-of-fit and robustness), determined by using a training set; and b) the predictivity of a model, determined by using an appropriate test set; and

- **a mechanistic interpretation**: The intent of this principle is to ensure that there is an assessment of the mechanistic associations between the descriptors used in a model and the endpoint being predicted, and that any association is documented. Where a mechanistic interpretation is possible, it can add strength to the confidence in the model already established on the basis of principles 1 to 4.

[9] Guidance document on the validation of (quantitative) structure-activity relationships [(Q)SARs] models. ENV/JM/MONO(2007)2, OECD, available from the OECD Internet site (http://www.oecd.org/dataoecd/55/35/38130292.pdf).

[10] Chapter R.6: QSARs and grouping of chemicals, dated May 2008.

The five OECD principles described above are summarised in Table 5.1, together with the basis for allocation of a score of 'POOR', 'FAIR' or 'GOOD' with respect to their potential for future regulatory acceptance.

Table 5.1: Assessment Criteria for the Quality and Relevance of QSARs (Potential for Future Regulatory Acceptance)

Categor-isation	Criteria				
	Defined Endpoint	**Unambiguous Algorithm**	**Defined Applicability Domain (AD)**	**Appropriate Goodness-of-fit, Robustness (Internal) and Predictivity (External)**	**Mechanistic Interpretation**
POOR	No REACH endpoint	Not publically available	Not available	Not tested (or tested and bad outcome)	Not based on a mechanistic interpretation
FAIR	REACH endpoint but not well described/ No REACH endpoint but comparable	Available but not extensively described	Partly described	Partly tested (internal or external)	Unknown or not mentioned
GOOD	REACH endpoint and well described	Available and properly described	Properly described	Tested and positive outcome	Based on a mechanistic interpretation

Note that the criteria were not assessed separately for each QSAR, rather the criteria were used to assign a general rating. In the event that QSARs for a certain endpoint scored differently for different criteria, the expert judgement of the study team was used to evaluate the overall 'average' performance based on a case-by-case weight of evidence approach.

For *in vitro* methods, internationally agreed test development criteria - especially the European Centre for the Validation of Alternative Methods (ECVAM) pre-validation criteria - were used to assess quality and relevance. Of these, the most important pre-validation criteria are:

- biological and/or mechanistic relevance of the test method;
- test system used and its relation to the tissue/organ/species of interest;
- parameter and endpoint measured and its/their relation to the relevant mechanism(s) of action in the species of interest;
- reduction, refinement or replacement of animal testing;
- improvement compared to existing methods; and
- reliability of the test method.

The basis for assessment is the ECVAM criteria as set out in Table 5.2. Note again that the criteria were not assessed separately for each *In-vitro* method, rather the criteria were used to assign a general rating. In the event that *In-vitro* methods for a certain endpoint scored differently for different criteria, the expert judgement of the

study team was used to evaluate the overall 'average' performance based on a case-by-case weight of evidence approach.

Table 5.2: Assessment Criteria for *In-vitro* Methods					
Categor-isation	**Biological/ Mechanistic Relevance of Test Method**	**Test System Related to Target of Interest?**	**Defined, Correct REACH Endpoint?**	**Reduction, Refinement or Replacement/ Improvement on Existing?**	**Reliability?**
POOR	No relevance of test method	No	No REACH endpoint	Refinement No	Poor
FAIR	Unknown	Yes	A REACH endpoint but not properly described	Reduction Partly	Fair
GOOD	Good relevance	Yes	Endpoint is a REACH endpoint and well described	Replacement Yes	Good

5.8 Domain for QSAR and In Vitro Methods Applicable to 1 to 10 Tonne Substances

5.8.1 QSARs

The assessments undertaken as part of RPA (2006) have been updated in response to developments since 2006, again based on expert judgement. It should be noted that only a screening assessment of the QSAR domain could be conducted for the current report. As such, the assessments given are based on the preliminary testing of a randomly selected part of the 2018 pre-registration substance list.

The assessment distinguished test methods as POOR, FAIR and GOOD categories, as summarised in Table 5.3.

Table 5.3: Assessment Criteria for QSAR	
POOR	QSAR model poorly applicable to 1 to 10 tonnes substances
FAIR	QSAR model fairly applicable to 1 to 10 tonnes substances
GOOD	QSAR model good applicable to 1 to 10 tonnes substances

Note that the criteria were not assessed separately for each QSAR, rather the criteria were used to assign a general rating. In the event that QSARs for a certain endpoint were rated differently for different criteria, the expert judgement of the team was used to evaluate the overall average performance.

5.8.2 *In Vitro* Methods

In contrast to QSARs, the issue of domain cannot be assessed in the case of *in vitro* assay methods because an assessment of domain is rarely available from literature

reviews; consideration of the other two criteria (performance and regulatory relevance) is however still relevant for these methods.

5.9 The Relevance/Acceptance for Regulatory Purposes of QSAR Models and In Vitro Methods

5.9.1 Current Level of Acceptance

Consideration of regulatory acceptance has been based on an assessment of compliance to criteria used by regulatory bodies like ECHA and other organisations such as the OECD which has played a key role in developing validated and agreed QSARs.

QSARs

Neither ECHA nor any other relevant EU body has published a list of 'regulatory accepted' QSARs *per se*. ECHA does, however, provide endpoint-specific guidance on the use of QSARs within a regulatory context (ECHA, undated). For some endpoints, particular QSARs are explicitly not recommended or not mentioned. In other cases, particular QSARs are mentioned or in some instances even recommended. Because they are the most recent published sources with respect to the regulatory acceptance of different QSARs, such recommendations in the ECHA and other EU relevant guidance documents were used as an indicative measure of the current relevance and acceptability of the methods for use within REACH, based on the criteria summarised in Table 5.4.

Table 5.4: Assessment Criteria for Current Level of Regulatory Acceptance of QSARs	
POOR	No mentioning in EU official document (e.g. ECHA Guidance) or statement that the QSAR cannot be reliably used.
FAIR	Mentioning in EU official document (e.g. ECHA Guidance) without explicit statement that QSAR can be used if applicable to the substance of interest.
GOOD	Explicit statement in EU official document (e.g. ECHA Guidance) that QSAR can be used if applicable to the substance of interest.

In Vitro Methods

Regulators will only accept *in vitro* alternatives to *in vivo* animal tests if the new methods and/or strategies will allow them to assess hazards with **at least the same level of reliability** as the current animal tests. The Organization for Economic Cooperation and Development (OECD) also plays a pivotal role in the process of acceptance of *in vitro* test methods by ensuring that individual *in vitro* toxicity tests can be adopted as recognised OECD Test Guidelines (TG) only after successful completion of a rigorous validation process. OECD TGs provide standardised protocols which ensure that tests conducted in one country will be accepted for assessment in another member state, under the OECD decision of 1981 on Mutual Acceptance of Data. However, some *in vitro* tests may be recognised by the EU before they are fully accepted as OECD test.

Validation of any alternative toxicological test method is the process by which the relevance and reliability of a test method are established for a particular purpose. Relevance refers to the scientific value of the method whereas reliability refers to the reproducibility of the results. Validation is now considered as one of the most important challenges to introducing alternative testing in the regulations. During the last decade, ECVAM (European Centre for the Validation of Alternative Methods at the European Commission's Joint Research Centre) and the OECD have published an important number of guidelines and other supporting material to better inform on the validation principles and the overall validation process. In September 2009, the European Commission, through the Joint Research Centre's Institute for Health and Consumer Protection (IHCP), has also launched a new website ***Tracking System for Alternative Test methods Review Validation and Approval*** **(TSAR)** designed to discuss and track the development of new alternative test.

The process of validation and regulatory approval of ***in vitro*** **tests or of tests involving organisms at lower taxonomic levels than vertebrates** may be subdivided into four main stages: Pre-validation, Validation, Peer Review and Regulatory Acceptance.

- A **Pre-validation** study is a small-scale inter-laboratory study, carried out to ensure that the protocol of a test method is sufficiently optimised and standardised for inclusion in a formal validation study and to obtain a preliminary assessment of its relevance and reliability.

- A **Validation** study is a large-scale inter-laboratory study, designed to assess the relevance and reliability of an optimised method for a particular purpose.

- After completing validation studies and when a new method is proposed, **Peer Review** panels are arranged, which should assess the usefulness and risk of the proposed method, eventually coming to a consensus on its validation status, which is a statement on the extent to which an alternative test method is considered relevant and reliable for a particular purpose, based on a scientific considerations.

- Before reaching **Regulatory Acceptance**, the degrees of reliability and relevance in a particular regulatory context are again scrutinized by different regulatory bodies, following a rather complex process.

This scheme formed the basis to develop assessment criteria for the regulatory acceptance assessment carried out here, as summarised in Table 5.5.

Table 5.5: Assessment Criteria *In Vitro* Methods	
POOR	Not existing or in research and development phase
FAIR	In pre-validation/validation phase
GOOD	In regulatory acceptance phase

5.9.2 Future Level of Acceptance

QSARs

The criteria summarised in Table 5.1 have been used as the basis for expert judgement to produce estimates of the likely level of regulatory acceptance of QSARs for specific endpoints by the final phase-in registration deadline of 31 May 2018 (i.e. phase-in deadline for 1 to 10 tonne substances).

In Vitro Methods

The criteria and methods set out in Section 5.9.1, and summarised in Table 5.5 and current expert judgement have been used to estimate the likely regulatory acceptance of *in vitro* methods by the 2018 phase-in registration deadline. The peer reviewed assessment of the availability of non-animal alternatives test methods in the context of the testing of cosmetics has also informed this assessment (Adler *et al*, 2011).

5.10 Summary of Assessment for Reach Across, QSARs and *In Vitro* Methods

The use of read-across as a means of filling information requirements was discussed in Section 5.4. The assumptions that are made for this study about the likelihood that read across can be used to fill information for each specific end point are given in Table 5.6.

The likelihood of (Q)SARs and *in vitro* methods being able to provide information for the registration of 1 to 10 tonne substances has been assessed in detail (see Annex 2). Furthermore, predictions have been made as to the likely situation at the phase-in registration deadline for these substances (1 June 2018). The availability of QSAR and *in vitro* information to fulfil information requirements considered under registration options developed as part of this study, is summarised in Table 5.7. A summary of the past, present and predicted future availability of QSAR and *in vitro* methods is set out in Table 5.8.

From Table 5.8 it can be seen that for some endpoints QSARs are well advanced/ developed compared to *in vitro* methods, while for other endpoints *in vitro* methods are more developed than QSARs/QSPR. However, in many cases a combination of QSARs and *in vitro* methods would be recommended as part of an integrated testing strategy (ITS). Several new developments (since 2006) have been identified in the literature and from EU-funded research projects that have improved the applicability, in some cases, of alternative methods. However, it is also concluded that the estimated applicability and availability of alternative methods was slightly over-optimistic in the 2006 assessment, at least for some of the endpoints. More realistic estimates based on the latest validation studies, published expert reviews and experience (IHCP & JRC, 2010; Worth *et al*., 2011; Adler et al., 2011) have therefore been adopted here. Looking to 2018, it is now anticipated that the QSARs for environmental endpoints will improve, the *in vitro* methods for acute toxicity, skin

sensitisation and repeated dose toxicity will also improve to some degree, and that model batteries and/or ITS will improve QSAR predictions for some other human health endpoints.

Table 5.6: Likelihood that Read Across will Fulfil Data Requirements

Endpoint	Test	Relevant CLP Classification	Likelihood of Read-across (P %)
Human Health			
Skin irritation/ corrosion	*In vitro* skin corrosion	Skin corrosive (1A, 1B & 1C)	11.0%
Skin irritation/ corrosion	*In vitro* skin irritation	Skin irritation (2)	11.0%
Skin irritation/ corrosion	*in vivo* skin irritation	Skin irritation (2)	11.0%
Eye irritation	*In vitro* eye irritation	Serious eye damage/irritation (1 &2)	11.0%
Eye irritation	*In vivo* eye irritation	Serious eye damage/irritation (1 &2)	
Skin sensitisation	*In vivo* LLNA	Skin sensitiser (1)	18,5%
Mutagenicity	Prokaryote*: In vitro* gene mutation bacteria	Positive test	11.5%
Mutagenicity	Eukaryote: *In vitro* cytogenicity	Germ cell mutagenicity (2)	11.5%
Mutagenicity	Eukaryote: *In vitro* gene mutation	Germ cell mutagenicity (2)	11.5%
Acute toxicity	Oral	Acute oral toxicity (1-4) & STOT SE (1-3)	7.5%
Acute toxicity	Inhalation	Acute inhalation toxicity (1-4) & STOT SE (1-3)	7.5%
Acute toxicity	Dermal	Acute dermal toxicity (1-4) & STOT SE (1-3)	7.5%
Repeat dose toxicity	Short term (1 route only)	Single target organ toxicity - repeated exposure (STOT RE 1 and 2)	13.0%
Reproductive toxicity	Screening for repro or developmental (OECD 421 or 422)	Reproductive toxicants (1B and 2)	24.0%
Toxicokinetics	Assessment of available information only	None	-
Environmental			
Aquatic Toxicity	Invertebrate - short-term	Hazardous to the aquatic environment (acute 1 & chronic 1-4)	12.5%
Aquatic Toxicity	Algal - short-term	Hazardous to the aquatic environment acute (1)	12.5%
Aquatic Toxicity	STP: Activated sludge respiration inhibition	Hazardous to the aquatic environment acute (1)	12.5%
Aquatic Toxicity	Fish – short-term	Hazardous to the aquatic environment acute (1)	12.5%
Degradation	Biotic - Ready biodeg	Screening for vB in vPvB	0%
Degradation	Biotic - Ready biodeg	Screening for B in PBT	0%
Degradation	Abiotic - Hydrolysis	Screening for vP (in vPvB)	0%
Degradation	Abiotic - Hydrolysis	Screening for P in PBT	0%
Fate and behaviour	Adsorption/ desorption[5]	Screening for vP (in vPvB)	0%
Fate and behaviour	Adsorption/ desorption[5]	Screening for P in PBT	0%

Table 5.7: Summary of Availability of QSAR and *In Vitro* Information to Fulfil Information Requirements									
Data category/ Endpoint	**Minimum Data Requirement under REACH (Y/N)**			**Availability of QSARs (incl. Expert Systems)**			**Availability of In Vitro Methods**		**Future Options / New Developments to meet Information Requirements**
	Tonnage category			**Screening for Annex III (Y/N)**	**Replace Test (N, C&L, EndPt[2])**	**Only Needs Phys-chem or Annex VI Data (N/Scr/C&L/Y)[2]**	**Screening for Annex III (Y/N)**	**Replace In Vivo Test (N, C&L, EndPt)**	
	1 to 10: Phase-in, Non-Annex III	**1 to 10: Other**	**10 to 100**						
Physicochemical Endpoints[1]									
Physical state	Y	Y	Y	-	-	-	-	-	-
Melting/Freezing point	Y	Y	Y	-	N	-	-	-	-
Boiling point	Y	Y	Y	-	EndPt	Y	-	-	-
Relative density	Y	Y	Y	-	EndPt	Y	-	-	-
Vapour pressure	Y	Y	Y	-	EndPt	Y	-	-	-
Surface tension	Y	Y	Y	-	N	-	-	-	-
Water solubility	Y	Y	Y	-	EndPt	Y	-	-	-
Partition coefficient (K_{ow})	Y	Y	Y	-	EndPt	Y	-	-	-
Flashpoint	Y	Y	Y	-	N	-	-	-	-
Flammability	Y	Y	Y	-	N	-	-	-	-
Explosive properties	Y	Y	Y	-	N	-	-	-	-
Self-ignition temperature	Y	Y	Y	-	N	-	-	-	-
Oxidising properties	Y	Y	Y	-	N	-	-	-	-
Granulometry	Y	Y	Y	-	N	-	-	-	-
Stability in organic solvents	N	N	N	-	N	-	-	-	-
Dissociation constant	N	N	N	-	EndPt	Y	-	-	-
Viscosity	N	N	N	-	N	-	-	-	-
Adsorption/desorption	N	N	Y	-	EndPt	Y	-	-	-

Table 5.7: Summary of Availability of QSAR and *In Vitro* Information to Fulfil Information Requirements									
Data category/ Endpoint	**Minimum Data Requirement under REACH (Y/N)**			**Availability of QSARs (incl. Expert Systems)**			**Availability of In Vitro Methods**		**Future Options / New Developments to meet Information Requirements**
	Tonnage category			**Screening for Annex III (Y/N)**	**Replace Test (N, C&L, EndPt[2])**	**Only Needs Phys-chem or Annex VI Data (N/Scr/C&L/Y)[2]**	**Screening for Annex III (Y/N)**	**Replace In Vivo Test (N, C&L, EndPt)**	
	1 to 10: Phase-in, Non-Annex III	**1 to 10: Other**	**10 to 100**						
Human Health Endpoints									
Acute toxicity	N	Y (oral)	Y (+ 1 ROE)	Y	C&L	Y	Y	C&L	Several *in vitro* test proposals from the A-Cute-Tox project have been pre-validated and are considered useful for screening purposes. However, it will take several years to obtain formal validation and regulatory acceptance. In 2005, an ECVAM Working Group estimated the timeframe for a replacement method for acute systemic toxicity to be more than 10 years (i.e. by 2015). The identified QSAR models should be further investigated related to their apparently high degree of false negatives
Skin irritation/corrosion	N	Y	Y	Y	EndPt	Y	Y	EndPt	Note that it has been assumed that for this endpoint, a quantitative estimation (such as NOAEL or LOAEL) is not per se required to fulfil the data requirements for risk assessment purposes
Eye irritation	N	Y	Y	Y	C&L	Y	Y	C&L	
Respiratory irritation	N	N	N	N	N	-	N	N	Skin irritation/corrosion information can also inform on respiratory irritation potential
Skin sensitisation	N	Y	Y	Y	C&L	Y	N	N	By 2013, no full replacement of animal methods will be available for skin sensitising potency assessment. The most positive view of the timing for this is another 7-9 years (2017-2019) but alternative methods able to discriminate between sensitizers and non-sensitizers (for the purpose of classification) might become available earlier (Adler *et al*., 2011). The current QSARs lack of full transparency and in some cases lack of established applicability domain means that their use whilst valuable is probably best limited to supporting information in a weight of evidence assessment as part of an Integrated Testing Strategy (ITS) (Patlewicz & Worth, 2008). The ITS is the most promising strategy to improve both domain and performance by using robust mechanistic based QSARs developed within identified reaction chemistry domains.

Table 5.7: Summary of Availability of QSAR and *In Vitro* Information to Fulfil Information Requirements									
Data category/ Endpoint	**Minimum Data Requirement under REACH (Y/N)**			**Availability of QSARs (incl. Expert Systems)**			**Availability of In Vitro Methods**		**Future Options / New Developments to meet Information Requirements**
	Tonnage category			**Screening for Annex III (Y/N)**	**Replace Test (N, C&L, EndPt[2])**	**Only Needs Phys-chem or Annex VI Data (N/Scr/C&L/Y)[2]**	**Screening for Annex III (Y/N)**	**Replace In Vivo Test (N, C&L, EndPt)**	
	1 to 10: Phase-in, Non-Annex III	**1 to 10: Other**	**10 to 100**						
Respiratory sensitisation	N	N	N	N	N	-	N	N	-
Repeat dose toxicity	N	N	Y	N	N	-	N	N	The 2005 ECVAM working group proposed the following timeframe for the validation of partial replacement methods for liver, kidney, inhalation, and neurotoxicity for 28-day and 90-day repeat dose testing (Prieto, *et al.*, 2005) – (most up-to-date relevant information available): 
Specific organ toxicity	N	N	Y	N	N	-	N	N	
Reproductive toxicity	N	N	Y (limited)	N	N	-	N	N	In vitro tests, QSARs or a combination in an ITS are insufficiently developed to meet information requirement without testing. However, some could be sufficiently developed for screening purposes but since applicability domain is expected to be limited, it is anticipated that the available alternative methods will not be widely applicable to 1 to 10 tonnes substances. An eventual replacement method will consist of a number of *in vitro* tests used in a tiered testing strategy but a timeframe for a full replacement method has not been predicted at this time (AltTOX, 2011).
Developmental toxicity	N	N	Y (possible)	N	N	-	N	N	

Table 5.7: Summary of Availability of QSAR and *In Vitro* Information to Fulfil Information Requirements									
Data category/ Endpoint	**Minimum Data Requirement under REACH (Y/N)**			**Availability of QSARs (incl. Expert Systems)**			**Availability of In Vitro Methods**		**Future Options / New Developments to meet Information Requirements**
	Tonnage category			**Screening for Annex III (Y/N)**	**Replace Test (N, C&L, EndPt[2])**	**Only Needs Phys-chem or Annex VI Data (N/Scr/C&L/Y)[2]**	**Screening for Annex III (Y/N)**	**Replace In Vivo Test (N, C&L, EndPt)**	
	1 to 10: Phase-in, Non-Annex III	**1 to 10: Other**	**10 to 100**						
Mutagenicity - prokaryote	N	Y	Y	Y	C&L	Y	Y	C&L	When QSAR model batteries can be used for assessing the mutagenicity of a substance, the results can mainly be used for C&L purposes. An ECVAM panel proposed that total replacement of animal testing for genotoxicity/mutagenicity would also require models for evaluating toxicokinetics and metabolism. *In vitro* genotoxicity tests also need to be modified to use cell lines relevant to the target organs of interest which for the purposes of predicting heritable germ cell damage would require standardization and validation of *in vitro* assays in mammalian germ cells. The oversensitivity of the *in vitro* models also needs to be addressed to satisfy the needs of industry. The panel also indicated that progress would depend upon advances in the fields of toxicogenomics and toxicokinetics, as well as availability of funding and resources (AltTOX, 2011). For QSARs, there is a need for further research aimed at developing and assessing model batteries and ITS. This is to some extent already planned in the ANTARES project.
Mutagenicity - eukaryote	N	N	Y	Y	C&L	Y	Y	C&L	
Carcinogenicity	N	N	N	Y	C&L	Y	Y	C&L	The ECVAM Task Force on Carcinogenicity concluded that the multiple stages and complex biology of carcinogenesis cannot be adequately modeled by *in vitro*/*in silico* approaches at this time to allow replacement of testing for this REACH endpoint and that a full replacement battery will not be available within the next 10 years (i.e. by 2021). This is similar to projections on the prospects for QSARs as for mutagenicity (AltTOX, 2011).
Toxicokinetics	N	N	N	N	N	-	N	N	

Table 5.7: Summary of Availability of QSAR and *In Vitro* Information to Fulfil Information Requirements									
Data category/ Endpoint	**Minimum Data Requirement under REACH (Y/N)**			**Availability of QSARs (incl. Expert Systems)**			**Availability of In Vitro Methods**		**Future Options / New Developments to meet Information Requirements**
	Tonnage category			**Screening for Annex III (Y/N)**	**Replace Test (N, C&L, EndPt[2])**	**Only Needs Phys-chem or Annex VI Data (N/Scr/C&L/Y)[2]**	**Screening for Annex III (Y/N)**	**Replace In Vivo Test (N, C&L, EndPt)**	
	1 to 10: Phase-in, Non-Annex III	**1 to 10: Other**	**10 to 100**						
Environmental Endpoints									
Aquatic invertebrate - short-term	N	Y	Y	Y	C&L	Y	N	N	QSARs as an alternative for ecotoxicity testing for risk assessment purposes are mainly in a weight of evidence context (e.g. for the prediction of relative species sensitivities during PNEC derivation) but not as a full replacement of the testing requirement. CLP allows the use of expert judgement in employing non-testing information such as QSARs, the classification of data deficient substances could potentially be conducted in the absence of any experimental acute data. Further QSAR research should focus on reactive and specific toxic mode of action to extend QSAR domain of current approaches. Assessment of long-term effect is usually done by extrapolating short-term effects rather than employing alternative methods. Existing *in vitro* methods are still insufficiently developed.
Aquatic invertebrate – long-term	N	N	N	N	N	-	N	N	
Aquatic algal short-term	N	Y	Y	Y	C&L	Y	N	N	
Aquatic fish –short term	N	N	Y	Y	C&L	Y	Y	C&L	
Aquatic fish – long-term	N	N	N	N	N	-	N	N	
Degradation – biotic	N	(Y) (limited)	Y	Y	C&L	Y	N	N	It is a general rule that when no useful information on degradability is available - either experimentally-derived or estimated - the substance should be regarded as not readily or not rapidly degradable and (Q)SAR prediction can be used as supporting evidence of this
Degradation - abiotic	N	N	Y	Y	N	Y	N	N	-
STP - Microorganisms	N	N	Y	N	N	-	N	-	-
Bioconcentration/ Bioaccumulation	N	N	N	Y	EndPt	Y	N	-	Note that predicted BCFs are not relevant for classification purposes or PBT assessment because the criteria for long-term hazard employ a cut off relating to log Kow, when the preferred type of information, measured BCF on an aquatic organism is not available. Predicted BCFs can be used for first tier risk assessment.

Table 5.7: Summary of Availability of QSAR and *In Vitro* Information to Fulfil Information Requirements									
Data category/ Endpoint	**Minimum Data Requirement under REACH (Y/N)**			**Availability of QSARs (incl. Expert Systems)**			**Availability of In Vitro Methods**		**Future Options / New Developments to meet Information Requirements**
	Tonnage category			**Screening for Annex III (Y/N)**	**Replace Test (N, C&L, EndPt[2])**	**Only Needs Phys-chem or Annex VI Data (N/Scr/C&L/Y)[2]**	**Screening for Annex III (Y/N)**	**Replace In Vivo Test (N, C&L, EndPt)**	
	1 to 10: Phase-in, Non-Annex III	**1 to 10: Other**	**10 to 100**						
Aquatic sedimentary sp. toxicity	N	N	N	N	N	-	N	-	There are no valuable alternatives for these endpoints. However, these endpoints are usually estimated from other endpoints. Sediment and terrestrial toxicity can be determined from aquatic toxicity and equilibrium partitioning. Avian toxicity can be determined from other mammalian tests (oral route) for human health purposes.
Avian toxicity	N	N	N	N	N	-	N	-	
Terrestrial toxicity	N	N	N	N	N	-	N	-	
PBT & vPvB assessment	Y (limited)	Y (limited)	Y	-	-	-	N	-	-

Notes
1. For several of the physicochemical endpoints, full test replacements are available to assist in addressing data gaps provided adequate information (usually chemical structure, SMILES code and/or other physicochemical properties) is available on the substance. Testing requirements for these endpoints could in principle be reduced or replaced by QSPR estimates in several cases. However, the testing requirements for these endpoints are typically included for other reasons such as low testing cost, no vertebrate tests, readily available tests (e.g. due to other legislative requirements) and need for robust estimates since these parameters are typically used to predict/inform other toxicological and ecotoxicological endpoints.
2. Only Needs Physchem (excl. SMILES) or Annex VI physic-chemical properties
N = cannot replace testing
C&L = Can replace testing but only for the C&L under CLP
EndPt = Can replace testing for REACH endpoint and for C&L under CLP

Table 5.8: REACH Data Requirements for Substances and Assessment of Other Information Sources												
Data category/ Endpoint	**QSAR (incl. Expert Systems)**								**In Vitro**			
	QSAR Performance			**QSAR Domain**			**Linked Domain**	**QSAR Regulatory Acceptance**	**Performance**		**Regulatory Acceptance**	
	2006	**2012**	**2018**	**2006**	**2012**	**2018**	**2012**	**2012**	**2012**	**2018**	**2012**	**2018**
Physicochemical Properties												
Melting/Freezing point	POOR	POOR	POOR	POOR	POOR	POOR	PC 1	POOR	-	-	-	-

Table 5.8: REACH Data Requirements for Substances and Assessment of Other Information Sources												
Data category/ Endpoint	**QSAR (incl. Expert Systems)**								**In Vitro**			
	QSAR Performance			**QSAR Domain**			**Linked Domain**	**QSAR Regulatory Acceptance**	**Performance**		**Regulatory Acceptance**	
	2006	**2012**	**2018**	**2006**	**2012**	**2018**	**2012**	**2012**	**2012**	**2018**	**2012**	**2018**
Boiling point	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	PC 2	GOOD	-	-	-	-
Relative density	NA	GOOD	GOOD	NA	GOOD	GOOD	PC 3	GOOD	-	-	-	-
Vapour pressure	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	PC 2	GOOD	-	-	-	-
Surface tension[1]	FAIR	POOR	POOR	FAIR	POOR	POOR	PC 4	POOR	-	-	-	-
Water solubility	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	PC 5	GOOD	-	-	-	-
Partition coefficient (K_{ow})	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	PC 6	GOOD	-	-	-	-
Flashpoint	NA	POOR	POOR	NA	POOR	POOR	PC 7	POOR	-	-	-	-
Flammability	NA	POOR	POOR	NA	POOR	POOR	PC 8	POOR	-	-	-	-
Explosive properties	NA	POOR	POOR	NA	POOR	POOR	PC 9	POOR	-	-	-	-
Self-ignition temperature	NA	POOR	POOR	NA	POOR	POOR	PC 10	POOR	-	-	-	-
Oxidising properties	NA	POOR	POOR	NA	POOR	POOR	PC 11	POOR	-	-	-	-
Granulometry	-	-	-	-	-	-	-	-	-	-	-	-
Stability in organic solvents	NA	POOR	POOR	NA	POOR	POOR	PC 13	POOR	-	-	-	-
Dissociation constant	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	PC 14	GOOD	-	-	-	-
Viscosity	NA	FAIR	FAIR	NA	FAIR	FAIR	PC 15	GOOD	-	-	-	-
Human Health Endpoints												
Acute	FAIR	FAIR	GOOD	FAIR	FAIR	GOOD	HH 1	FAIR	FAIR	GOOD	FAIR	GOOD
Skin irritation/corrosion	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	HH 2	GOOD	GOOD	GOOD	GOOD	GOOD
Eye irritation	FAIR	FAIR	GOOD	FAIR	FAIR	GOOD	HH 2	GOOD	GOOD	GOOD	GOOD	GOOD
Skin sensitisation	FAIR	FAIR	FAIR	GOOD	FAIR	GOOD	HH 3	FAIR	POOR	FAIR	POOR	FAIR
Respiratory sensitisation[1]	GOOD	POOR	FAIR	POOR	POOR	FAIR	HH 3	POOR	POOR	POOR	POOR	POOR
Repeat dose toxicity	FAIR	FAIR	FAIR	POOR	POOR	FAIR	HH 4	POOR	FAIR	GOOD	POOR	FAIR
Specific organ toxicity	NA	POOR	POOR	NA	POOR	POOR	HH 4	POOR				
Reproductive toxicity	POOR	POOR	POOR	FAIR	POOR	POOR	HH 5	FAIR	FAIR	FAIR	FAIR	FAIR
Developmental toxicity	POOR			FAIR			HH 5		FAIR	FAIR	FAIR	FAIR
Mutagenicity - prokaryotic[1]	GOOD	FAIR (GOOD as part of ITS)	GOOD	GOOD	GOOD	GOOD	HH 6	GOOD	GOOD	GOOD	GOOD	GOOD
Mutagenicity - eukaryotic[1]							HH 6		GOOD	GOOD	GOOD	GOOD

Table 5.8: REACH Data Requirements for Substances and Assessment of Other Information Sources												
Data category/ Endpoint	**QSAR (incl. Expert Systems)**								**In Vitro**			
	QSAR Performance			**QSAR Domain**			**Linked Domain**	**QSAR Regulatory Acceptance**	**Performance**		**Regulatory Acceptance**	
	2006	**2012**	**2018**	**2006**	**2012**	**2018**	**2012**	**2012**	**2012**	**2018**	**2012**	**2018**
Carcinogenicity	GOOD	FAIR as part of ITS	GOOD	GOOD	GOOD	GOOD	HH 6	GOOD	FAIR	FAIR	FAIR	FAIR
Toxicokinetics	FAIR	POOR	FAIR	GOOD	POOR	FAIR	HH 7	POOR	POOR	POOR	POOR	POOR
Environmental Endpoints												
Adsorption/ desorption	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	ENV 1	GOOD	-	-	-	-
Degradation – biotic[1]	GOOD	FAIR	GOOD	GOOD	GOOD	GOOD	ENV 2	GOOD	-	-	-	-
Degradation - abiotic	GOOD	GOOD	GOOD	POOR	POOR	FAIR	ENV 3	FAIR	-	-	-	-
Bioaccumulation	GOOD	GOOD	GOOD	GOOD	FAIR	FAIR	ENV 4	GOOD	POOR	POOR	POOR	POOR
Aquatic invertebrate acute	GOOD	GOOD	GOOD	GOOD	FAIR	GOOD	ENV 4	FAIR	POOR	POOR	POOR	POOR
Aquatic invertebrate chronic[1]	GOOD	POOR	FAIR	POOR	FAIR	FAIR	ENV 4	POOR	POOR	POOR	POOR	POOR
Aquatic algae	GOOD	GOOD	GOOD	GOOD	FAIR	GOOD	ENV 4	FAIR	POOR	POOR	POOR	POOR
Aquatic fish –acute	GOOD	GOOD	GOOD	GOOD	FAIR	GOOD	ENV 4	FAIR	FAIR	FAIR	GOOD	GOOD
Aquatic fish – chronic	NA	POOR	FAIR	NA	FAIR	FAIR	ENV 4	FAIR	POOR	POOR	POOR	POOR
Sediment toxicity	NA	POOR	POOR	NA	POOR	POOR	ENV 4	POOR	POOR	POOR	POOR	POOR
STP - Microorganisms	POOR	FAIR	FAIR	POOR	FAIR	FAIR	ENV 4	POOR	POOR	POOR	POOR	POOR
Avian toxicity	NA	POOR	POOR	NA	POOR	POOR	ENV 4	POOR	POOR	POOR	POOR	POOR
Terrestrial toxicity[1]	GOOD	FAIR	GOOD	POOR	FAIR	FAIR	ENV 4	POOR	POOR	POOR	POOR	POOR
PBT & vPvB assessment	NA	GOOD	GOOD	NA	FAIR	FAIR	-	FAIR	-	-	-	-

Notes:
NA = Not Assessed in 2006.
1. Estimates set out in RPA (2006) were based on information provided to RPA and expert judgement on that information at that time. Subsequent accumulation of evidence has demonstrated that in some instances the assessment of performance was overly optimistic.

5.11 Use of Different Information Sources for Registration

5.11.1 Introduction

Previously in this section we have discussed the applicability and potential use of alternative methods to generate the information needed for registration. Below we consider the actual use of different information sources for the registration of substances to date, as published by ECHA (ECHA, 2011a & ECHA, 2011b). When considering the registration information presented here, it is important to note that 90% of registrations to date relate to substances produced at 1,000 tonne or more per annum (of which 87% were submitted by large companies), and 21% of registrations relate to intermediates (ECHA, 2011a). However, despite these limitations in the available dataset, it represents the only information available on the practical use of different information sources for the submission of actual registration dossiers under REACH.

Percentages reflecting the degree to which the different information sources were used by registrants in 2010 to fulfil their registration requirements are set out by endpoint in Table 5.9 (ECHA, 2011b).

Table 5.9: Share of Information Types used to fulfil Obligations for the Different Endpoints

Endpoint	Experimental Studies (%)	Testing Proposals (%)	Alternative Methods (%)	No Data Needed (%)
Acute Toxicity	85		15	
Skin Irritation	78		22	
Eye Irritation	75		25	
Skin Sensitisation	63		37	
Repeated Dose Toxicity	67	7	26	
Genetic Toxicity In Vitro	77		23	
Genetic Toxicity In Vivo	41	1	32	26
Toxicity To Reproduction	42	10	48	
Developmental Toxicity	47	10	43	
Bioaccumulation Fish	15	1	84[1]	
Toxicity to Fish	75		25	
Long-term Toxicity to Fish	16	2	82[2]	
Long-term Toxicity to birds	7	1	92	
Long-term Toxicity to Mammals	2		7	91
Toxicity to Other Terrestrial Organisms	4		4	92

Source: Section 3.3 of ECHA's report on the use of alternatives to animal testing methods for registrations in 2010, p. 45 – 47 (ECHA, 2011b).
Notes.
1. Experimental data on invertebrates were counted as an alternative method.
2. Includes justification for omission.

Endpoint study records show that for greater than 100 tonne substances, registrants used data produced prior to the introduction of REACH as their main source of data for core and higher tier endpoints (ECHA, 2011b). The second most used source of information came from the application of read-across, especially for endpoints that would otherwise require longer term animal studies.

5.11.2 Animal Testing

The information requirements of Annex VII (1 to 10 tonne substances) and Annex VIII (10 to 100 tonne substances) include animal testing for several endpoints[11]. According to ECHA (2011b), the majority of tests carried out since 2009 (96.8% of all new experimental studies and 94% of all experimental *in vivo* studies) were done to close data gaps for these endpoints, as summarised in Table 5.10.

Table 5.10: New[1] Experimental Studies Conducted to fulfil REACH Requirements

	Total Studies	**Percentage of all Studies**	**Percentage of the *In Vivo* Studies**
In vitro VII and VIII	1,491	44.64	-
In vivo VII and VIII	1,742	52.16	94.21
In vivo IX and XX	107	3.20	5.79
Total	***3,349***	***100***	***100***

Note 1: All studies with references dated 2009 or later were considered as 'new'.

5.11.3 Alternative Methods

ECHA analysed 1,504 greater than 1,000 tonne registration dossiers to obtain detailed information on the types of alternative information sources being used by registrants, with the results of this analysis summarised in Table 5.11 (ECHA, 2011b), overleaf.

Table 5.11: Use of Different Methods for Annex VII to XI[1] Endpoints

Endpoints	**Percentage of Endpoint Study Records[2] (1 June 2008 to 28 February 2011)**							
	ES	**TP**	**RA**	**SO**	**WE**	**QS**	**MS**	**Total ESRs**
8.1 Skin irritation (*in vitro*)	76.6	0.0	11.9	0.6	10.6	0.0	0.3	329
8.1 Skin irritation (*in vivo*)	64.1	0.0	21.3	4.1	7.7	0.1	2.7	5,216
8.2 Eye irritation (*in vitro*)	86.6	0.0	7.0	0.6	2.9	0.0	2.9	172
8.2 Eye irritation (*in vivo*)	64.3	0.0	20.9	5.2	6.6	0.0	3.0	4,221
8.3 Skin sensitisation (*in vivo*)	55.4	0.5	20.8	7.0	13.7	0.0	2.6	3,754
8.4 Mutagenicity[3]	57.2	0.0	22.0	3.8	12.1	0.1	4.8	10,322
8.5 Acute toxicity (all routes)	56.9	0.0	21.4	9.2	8.7	0.1	3.7	12,874
8.6. Repeated dose toxicity (all routes & all study durations)	42.1	1.0	28.1	18.8	6.6	0.1	3.3	10,790
9.1 Aquatic toxicity (short-term fish)	52.6	0.0	20.2	1.8	14.2	2.1	9.1	6,942

Notes.
1. Data from 1,504 registration dossiers, as analysed in ECHA (2011b). Only (eco)toxicological endpoints of relevance to Annex VII or VIII are included.
2. Endpoint Study Record (ESR): IUCLID format of the technical dossier used to report study summaries and robust study summaries of the information derived for the endpoints set out in Annexes VII to XI. Note there are likely to be more than one ESR for the same endpoint.
3. Figures for Annex IX *in* vitro genotoxicity study, assumed for Annex VII *in vitro* prokaryote gene mutation study, and Annex VIII *in vitro* eukaryote studies.

Key:
ES: Experimental study (testing) | RA: Read-across | QS: (Q)SAR
TP: Testing proposal | WE: Weight of evidence | SO: Study omitted
MS: Miscellaneous: classified by the registrant as 'other' when describing 'study type'

[11] Acute toxicity, eye and skin irritation, skin sensitisation, sub-acute repeated dose toxicity, repeated dose / reproductive toxicity screening study, short-term toxicity on fish.

6. DATA ON SUBSTANCE PROPERTIES

6.1 The Classification and Labelling Inventory

6.1.1 Information on Hazardous Properties from the CLI

On 14 February 2012, ECHA published the Classification and Labelling Inventory (CLI) containing information from over three million notifications covering over 116,000 substances, including polymers. Since then, there have been regular up-dates with the version of the CLI used for the analysis presented below being that dated 31 May 2012 (ECHA, 2012a). Since this date, additional substances have been added to the CLI, with an ECHA press release in September 2012 indicating that over 120,000 substances had been notified, by a total of 5.3 million notifiers. This figure of 120,000 includes classified substances, a relatively small number of non-classified substances (e.g. around 12,000) and a relatively small number of polymers (over 1,100).

The CLI was searched (on 31 May 2012) to identify substances with different hazard classifications or combinations of classifications. There are, however, concerns regarding the robustness of the information from the CLI for statistical analysis, as explained below:

1. The CLI includes all classification and labelling (C&L) notifications for each substance and, on searching the CLI, it is clear that there are multiple entries for the same substance which may differ markedly. For example, entries differ even for the simplest substances such as hydrogen, with most notifiers' classifying hydrogen as a Flammable Gas (cat. 1) plus a classification relevant to the state in which it is supplied. However, one notifier has also classified hydrogen as a mutagen cat. 1B and a carcinogen cat. 1A (due to the presence of a classified impurity[12]); another notifier classified hydrogen as an oxidising gas cat. 1 and a respiratory sensitiser cat. 1 but not as a flammable gas. In cases such as hydrogen, it may be simple to exclude unlikely classifications from statistical analysis, but this is clearly not practical for all substances in the absence of detailed expert knowledge on the properties of each of the substances in question. In the 31 May 2012 update of the CLI, there is an agreed classification and labelling for a far higher proportion of substances. It is to be expected that over time the situation will improve further as more notifiers and REACH registrants make every effort to come to an agreed entry to be included into the CLI, as required under Article 41 of CLP. This process has not yet fully started – ECHA is developing an IT platform that will facilitate contacts between notifiers and registrants.

2. No reasons are provided for the classification decisions notified. Therefore, it is not possible to determine whether there may be justifiable reasons for the variations in classifications notified for the same substance (e.g. due to variations

[12] Confirmed by ECHA, *pers. comm.*

in impurities, etc.) or whether these variations simply represent errors or misunderstandings on the part of some notifiers. However, this will have been discussed between notifiers seeking to fulfil their obligations under Article 41 of CLP.

3. When a search is made on the CLI based on classification, a substance will be identified if any of its notifiers classified that substance under the classification(s) included in the search string. Hence, hydrogen will be identified as a carcinogens cat. 1A in any searches undertaken for this classification (see point 1, above – as noted, this particular classification is due to the presence of a classified impurity).

Despite the issues set out above, the CLI is the only source currently available that can provide an overview of all CLP classifications for all substances. The CLI has therefore been used for this study to provide estimates of the maximum percentage of substances that may be expected to have classifications, where such estimates are needed for the impact assessment. It is acknowledged that the estimates thus derived will be subject to some uncertainty and confounding but, nonetheless, represent the most comprehensive dataset available for such purposes.

In order to convert the numbers of substances with particular classifications into percentages of all substances, it was necessary to estimate the number of all substances on the market in the EU in any quantity (i.e. the total sample from which the 120,000 substances in the CLI are drawn).

The White Paper (COM, 2001) estimated that there were approximately 100,000 substances on the market in the EU. The list of substances pre-registered under REACH has entries for approximately 150,000 substances supplied in quantities greater than one tonne (ECHA, 2009). As indicated above, as of the 31st May 2012, there were around 100,000 substances notified to the CLI, with this figure rising to 120,000 by October 2012 (with around 12,000 of these not classified).

Unlike the CLI, ECHA (2009) should not include polymers, and a search of ECHA (2009) for the phrase "polym" returned only around fifty substances. ECHA (2009) should also not include substances manufactured/imported in quantities below the 1 tonne registration threshold, unlike the CLI which should include all substances, regardless of quantity. In addition, ECHA (2009) should include both classified and non-classified substances, while there is no requirement to notify non-classified substances to the CLI. However, it is also recognised that there is great uncertainty attached to the ECHA (2009) figures. For example, many registrants pre-registered substances that may never be registered and the totals may include significant numbers of substances only manufactured/imported in quantities below one tonne per year.

Although the review carried out by Nordberg (2007) estimated that there were 70,000 chemicals commercially available in the EU in 2007, more recent work by Scheringer *et al* (2012) derived a figure of 127,000 based on CAS and SMILE numbers.

Given that the number of all substances is almost certain to be larger than the number with properties that meet the CLP criteria for classification, as not all substances have hazardous properties, the figure 150,000 substances as per pre-registration, has been assumed for the basis of this study[13]. This figure has been used to convert numbers of substances with a classification in the CLI to percentages of all substances on the market. For example, 3,469 substances have been classified by at least one notifier for Carcinogenicity Category 1A or 1B, with this then assumed to equate to 2% (i.e. 3,469 ÷ 150,000) of all substances.

It is further assumed that this percentage for all substances will apply equally well to 1 to 10 tonne substances.

It is important to note that where the percentages of substances with specific CLP classifications, or groups of classifications, quoted in this report are based on the CLI, these were calculated using data obtained from the CLI dated 31 May 2012.

In addition to the CLI, other sources of information on the percentage of substances with specific classifications were also sought in order to improve the robustness of (i.e. to correct) the CLI based estimates. The two main sources identified were Nordberg (2007) and RPA (2006), which are described below.

6.1.2 Nordberg (2007)

A 2007 study derived estimates of the percentages of 1,400 substances notified under the Dangerous Substances Directive 67/548/EEC (DSD) with classifications for four groups of classifications, as shown in Table 6.1 (Nordberg, 2007).

Table 6.1: Percentages of Substances with Specified Hazard Classifications - CLI/Nordberg

CLP Classifications	Percentage of Substances		Nordberg Grouping of DSD Classifications
	CLI	Nordberg	
Acute toxicity (1-4) (all routes)	38%	20%	Acute toxicity
STOT RE 1 & 2	3%	9%	Subacute toxicity
Skin corrosive/irritation (1 & 2) & serious eye damage/irritation (1 & 2)	67%	29%	Irritation
Respiratory or skin sensitisation (1)	10%	28%	Sensitisation

It is noted that the Nordberg (2007) estimated percentages are significantly lower than those calculated from the CLI for acute toxicity and irritation while being significantly higher for subacute toxicity and sensitisation. The differing data sets and groupings used for the two datasets may have influenced these differences, but no clear explanation has been identified.

[13] As of the 26th October 2012, the CLI contained around 1,100 entries with the word "polymer" in the notification, 8,518 entries had no classification, 90,126 entries had classification for at least one health endpoint, 31,664 entries had classification for at least one environment endpoint and 9,745 entries were classified for at least one physical hazard endpoint.

6.1.3 RPA (2006)

In 2006, the European Chemicals Bureau (ECB) provided RPA with details of substances notified under DSD with specific DSD classifications (from 2,924 substances) (RPA, 2006). These numbers were used to calculate percentages of substances with specific classifications, which have been compared to those calculated using the CLI in Table 6.2.

Table 6.2: Percentages of Substances with Specified Hazard Classifications - CLI/RPA (2006)

CLP Classifications	Percentage of Substances		DSD Classifications
	CLI	RPA (2006)	
Resp. Sens. 1	1.6%	1.0%	R 42 - May cause sensitization by inhalation
Skin Sens. 1	6.6%	28.3%	R 43 - May cause sensitization by skin contact
STOT RE 1 or 2	2.4%	9.3%	R 48 - Danger of serious damage to health by prolonged exposure
Carc. Cat 1A	0.6%	0.1%	Carcinogen Cat 1
Carc. Cat 1B	1.1%	1.0%	Carcinogen Cat 2
Carc. Cat 2	1.2%	1.1%	Carcinogen Cat 3
Mut. Cat 1A	0.0%	0.0%	Mutagen Cat 1
Mut. Cat 1B	0.5%	0.7%	Mutagen Cat 2
Mut. Cat 2	0.8%	1.8%	Mutagen Cat 3
Repr. Cat 1A	0.4%	0.03%	Reprotox Cat 1
Repr. Cat 1B	0.7%	0.8%	Reprotox Cat 2
Repr. Cat 2	1.4%	1.7%	Reprotox Cat 3

From the limitations of the data currently held in the CLI, as set out in Section 6.1.1, it would be expected that the estimates generated using the CLI data as it stood at the time of writing and as shown in Table 6.2 would tend to exaggerate the percentage of substances having hazardous properties (i.e. more substances identified with a given classification than is the case in reality due to notifications of what appear to be incorrect classifications). However, where data were available to RPA (2006), the estimates of percentage substance with specific classifications are very similar to those calculated from the CLI for most endpoints. The CLI percentages shown in Table 6.3 have therefore been used for the purposes of this study.

Table 6.3: Percentages of Substances with Specific CLP Classifications Calculated from the CLI dated 31 May 2012		
CLP Classification	**Number of Substances in CLI**	**Assumed Percentage of All Substances**
All Substances in CLI	98,898	66%
All Substances Classified and Unclassified (based on ECHA (2009)	150,000	100%
Human Health Classification		
Skin corrosive (1A, 1B & 1C)	8,154	5%
Skin irritation (2)	52,815	35%
Serious eye damage /irritation (1 &2)	63,592	42%
Skin sensitiser (1)	9,931	7%
Germ cell mutagenicity (2)	1,963	1%
Acute oral toxicity (1-4)	38,703	26%
Acute inhalation toxicity (1-4)	14,498	10%
Acute dermal toxicity (1-4)	12,939	9%
Single target organ toxicity - single exposure (STOT SE 1, 2 & 3)	45,158	30%
Single target organ toxicity - repeated exposure (STOT RE 1)	1,397	1%
Single target organ toxicity - repeated exposure (STOT RE 2)	2,473	2%
Single target organ toxicity - repeated exposure (STOT RE 1 & 2)	3,607	2%
Reproductive toxicants (1A & 1B)	1,581	1%
Reproductive toxicants (2)	2,056	1%
Any human health classification	*88,668*	*59%*
Environmental Classification		
Hazardous to the aquatic environment (acute 1)	13,554	9%
Hazardous to the aquatic environment (chronic 1 & 2)	14,253	10%
Hazardous to the aquatic environment (1, 2, 3 & 4)	26,492	18%
Any environmental classification	*30,917*	*21%*
Note: Numbers calculated as at 31 May 2012. Subsequent versions of the CLI have increased numbers of substances.		

6.2 Links between Hazard Endpoints and CLP Classification

6.2.1 Physicochemical Endpoints

It has been assumed that information for all of the physicochemical endpoints will be readily available or will be sourced at minimal cost.

6.2.2 Human Health Endpoints

The test methods available to provide data to fulfil the information requirements set out in Annex VII and Annex VIII were assessed drawing on published evidence where available or, in the absence of such data, expert insights into the anticipated performance characteristics of the specific test methods, in order to inform on the ability of the tests to identify properties that would lead to classification under CLP, as summarised in Table 6.4.

Table 6.4: Ability of Tests to Identify Properties for CLP Classification				
Endpoint from Annex VII or Annex VIII	**Test (code from Annex VII or Annex VIII)**	**Classification Possible**	**Assessed Accuracy of Test for Correctly Identifying Property Resulting in Classification (%)**	**Basis for Assessment of Test Performance**
Human Health Endpoints				
Skin irritation/ corrosion	*In vitro* skin corrosion (8.1)	Skin corrosive (1A, 1B & 1C)	95 %	Expert judgement informed by, e.g., ECVAM (2009)
Skin irritation/ corrosion	*In vitro* skin irritation (8.1)	Skin irritation (2)	80 %	Expert judgement informed by, e.g., ECVAM (2009)
Skin irritation/ corrosion	*in vivo* skin irritation (8.1.1)	Skin irritation (2)	95 %	Expert judgement informed by, e.g., ECVAM (2009)
Eye irritation	*In vitro* eye irritation (8.2)	Serious eye damage/irritation (1 &2)	80 %	Expert judgement informed by Eskes et al. (undated)
Eye irritation	*In vivo* eye irritation (8.2.1)	Serious eye damage/irritation (1 &2)	95 %	Expert judgement informed by Eskes et al. (undated)
Skin sensitisation	*In vivo* LLNA (8.3)	Skin sensitiser (1)	85%	Initial performance of LLNA assay indicated a predictivity of around 75% (SCCNFP, 2000). However, the estimate of 85% is based on a more recent assessment (Anderson et al., 2011) which suggests an accuracy of 86% is achievable
Mutagenicity	Prokaryote*: In vitro* gene mutation bacteria (8.4.1)	None but positive test can inform germ cell mutagenicity (2)	60 %	Based on estimated predictivity of the Ames test (Long, 2007 and Kirland et al 2005)
Mutagenicity	Eukaryote: *In vitro* cytogenicity (8.4.2)	Germ cell mutagenicity (2)	90 %	Based on estimates of the improvement in predictivity arising from use of one or more eukaryotic test models in conjunction with the Ames test (Kirkland et al., 2005 & Long, 2007)
Mutagenicity	Eukaryote: *In vitro* gene mutation (8.4.3)	Germ cell mutagenicity (2)	90 %	Based on estimates of the improvement in predictivity arising from use of one or more eukaryotic test models in conjunction with the Ames test (Kirkland et al., 2005 & Long, 2007)
Acute toxicity	Oral (8.5.1)[1]	Acute oral toxicity (1-4) & STOT SE (1-3)	100 %	100% assumes use of appropriate acute oral test methodology as basis for establishing acute oral classification

Table 6.4: Ability of Tests to Identify Properties for CLP Classification				
Endpoint from Annex VII or Annex VIII	**Test (code from Annex VII or Annex VIII)**	**Classification Possible**	**Assessed Accuracy of Test for Correctly Identifying Property Resulting in Classification (%)**	**Basis for Assessment of Test Performance**
Acute toxicity	Inhalation (8.5.2)[1]	Acute inhalation toxicity (1-4) & STOT SE (1-3)	75 %	Based on expert judgement. Inhalation route would inform on respiratory STOT SE classifications relating to acute exposures but not to all STOT SE
Acute toxicity	Dermal (8.5.3)[1]	Acute dermal toxicity (1-4) & STOT SE (1-3)	100 %	Based on expert judgement, assuming used in conjunction with acute data on other relevant routes
Repeat dose toxicity	Short term (1 route only)[2] (8.6.1)	Single target organ toxicity - repeated exposure (STOT RE 1 and 2)	85 %	Based on expert judgement. Estimate assumes potential exists for misclassification because of, for example, route-specific effects, limitations in study design (e.g. gaps in end points considered) or inappropriate dose duration to elicit response[14]
Reproductive toxicity	Screening for repro or developmental (OECD 421 or 422) (8.7.1)	Reproductive toxicants (1B and 2)	60 %	Based on expert judgement, assuming the use of screening study designs (OECD 421/422). These designs are known to be less predictive than definitive test designs (e.g. OECD, 414, 415 and 416), as discussed by Reuter et al (2003) and OECD (2008)
Toxicokinetics	Assessment of available information only (8.8.1)	None	Not relevant	No standard study designs. Testing to establish toxicokinetic behaviour is undertaken using substance specific study designs. Aspects relating to study design are further discussed by Cayen (1995)
Environmental Endpoints				
Aquatic Toxicity	Invertebrate - short-term (9.1.1)	Hazardous to the aquatic environment (acute 1 & chronic 1-4)	50 % for Acute 1; 5 % - for Chronic 1-4	Based on expert judgement informed by Reuschenbach et al (2008)
Aquatic Toxicity	Algal - short-term (9.1.2)	Hazardous to the aquatic environment acute (1)	50 %	Based on expert judgement informed by Reuschenbach et al (2008)

[14] Further discussion of study designs limitations available at http://www.oecd.org/chemicalsafety/testingofchemicals/44076587.pdf.

Table 6.4: Ability of Tests to Identify Properties for CLP Classification				
Endpoint from Annex VII or Annex VIII	**Test (code from Annex VII or Annex VIII)**	**Classification Possible**	**Assessed Accuracy of Test for Correctly Identifying Property Resulting in Classification (%)**	**Basis for Assessment of Test Performance**
Aquatic Toxicity	STP: Activated sludge respiration inhibition (9.1.4)	Hazardous to the aquatic environment acute (1)	50 %	Based on expert judgement informed by Reuschenbach et al (2008)
Aquatic Toxicity	Fish – short-term (9.1.3)	Hazardous to the aquatic environment acute (1)	70 %	Based on expert judgement informed by UN (2007) and Persoone G et al. (1990)
Degradation	Biotic - Ready biodegradation (9.2.1.1)	None	N/A	N/A
Degradation	Abiotic – Hydrolysis (9.2.2.1)	None	N/A	N/A
Fate and behaviour	Adsorption/ desorption (9.3.1)	None	N/A	N/A
Notes. 1. Oral route chosen as the default choice. However, costing for acute toxicity tests reflect the likelihood that some registrants will need to undertake tests for dermal or inhalation toxicity. 2. Oral route chosen as the default choice. However, costing for repeat dose toxicity tests reflect the likelihood that some registrants will need to undertake tests for dermal or inhalation toxicity.				

6.3 PBT/vPvB

In accordance with Art. 14 of the REACH Regulation, *"a chemical safety assessment shall be performed and a chemical safety report completed for all the substances subject to registration in accordance with this Chapter in quantities of 10 tonnes or more per year per registrant"* and *"shall include (…) persistent, bioaccumulative and toxic (PBT) and very persistent and very bioaccumulative (vPvB) assessment"* (Art. 14(3d)).

Substances which are PBT or vPvB in accordance with the criteria set out in Annex XIII of the Regulation may be included in Annex XIV (Authorisation list) (Art. 57(d) and (e)).

The criteria for the identification of PBT and vPvB substances set out in Annex XIII apply to all organic substances, including organo-metals, and are presented in Table 6.5. The criteria identified and used by the US EPA for the identification of PBT substances[15], the criteria set out in the Annex D of the Stockholm Convention[16] for Persistent Organic Pollutants and the cut off values used for the selection by the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic[17] are also reported for comparison.

From a comparison, it can be concluded that the criterion for identification of persistent substances used by the US EPA is less severe (except from the degradation half-life in fresh or estuarine water), while the criterion for the identification of very persistent substances is more severe than that which applies under REACH; in comparison, the Annex XIII criterion is likely to trigger more substances. With respect to the bioaccumulation criterion, the BCF used by the US EPA is half of the Annex XIII criterion, while the threshold values for very bioaccumulative substances are the same. The toxicity criteria are different, even if a parallel can be drawn between the NOEC and chronic values (ChV) for fish. The parameters considered for the Stockholm Convention persistence criterion have higher and lower thresholds, so it is not clear if they trigger more or less substances; however, the bioaccumulation criterion is equal to the very bioaccumulative criterion for identification of vB substances used by both REACH and the US EPA. The OSPAR Selection criteria are the most severe and likely to trigger a higher number of substances.

In order to reasonably predict the number of PBT/vPvB substances that will be identified under REACH and, consequently, the number of PBT substances manufactured or imported in quantities between one to ten tonnes, the different experiences and available databases have been assessed.

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15 http://www.pbtprofiler.net/criteria.asp

16 Available at Internet site: http://chm.pops.int/Convention/ConventionText/tabid/2232/Default.aspx

17 OSPAR (2005): Cut-off Values for the Selection Criteria of the OSPAR Dynamic Selection and Prioritisation Mechanism for Hazardous Substances, Annex 7, Reference number 2005-9, Malahide, Ireland. It must be noted that, in the light of the developments under the Water Framework Directive and the REACH Regulation, the selection and prioritisation of substances under the OSPAR Convention has been put on hold.

Table 6.5: Criteria for identification of PBT/vPvB/POP substances						
Criteria	**PBT (REACH)**	**vPvB (REACH)**	**PBT (US EPA)**	**vPvB (US EPA)**	**POP (Stockholm Convention)**	**PBT (OSPAR)**
Persistence Degradation half-life*:						
- in marine water	>60 days	>60 days	>60 days	>180 days	>60 days	>50 days
- in fresh or estuarine water	>40 days	>60 days	>60 days	>180 days	>60 days	>50 days
- in marine sediment	>180 days	>180 days	>60 days	>180 days	>180 days	>50 days
- in fresh or estuarine sediment	>120 days	>180 days	>60 days	>180 days	>180 days	>50 days
- in soil	>120 days	>180 days	>60 days	>180 days	>180 days	
Any evidence of persistency					X	
Bioaccumulation*						
Bioconcentration factor (BCF)	>2,000	>5,000	>1,000	>5,000	>5,000	≥500
Log K_{ow}					>5	≥4
Toxicity*						
NOEC for marine or freshwater organisms	<0.01 mg/l					≤0.1 mg/l
EC_{10}	<0.01 mg/l					
EC_{50}						≤1 mg/l
CMR[18]	X					X
STOT RE cat. 1 or 2[19]	X					
Fish ChV[20]			LC:** >10 mg/l MC : 0.1–10 mg/l HC: <0.1 mg/l			
Chronic toxicity for mammalian						X
Any evidence of toxicity					X	
Notes: * Any of the listed situations; ** LC: Low Concern; MC: Moderate Concern; HC: High Concern.						

18 *…the substance meets the criteria for classification as carcinogenic (category 1A or 1B), germ cell mutagenic (category 1A or 1B), or toxic for reproduction (category 1A, 1B, or 2) according to Regulation EC No 1272/2008*; (Annex XIII 1.1.3(b))

19 *…there is other evidence of chronic toxicity, as identified by the substance meeting the criteria for classification: specific target organ toxicity after repeated exposure (STOT RE category 1 or 2) according to Regulation EC No 1272/2008* (Annex XIII 1.1.3(c)).

20 *Chronic Value (ChV) is defined as the geometric mean of the no observed effect concentration (NOEC) and the lowest observed effect concentration (LOEC). This can be mathematically represented as: ChV = 10^([log (LOEC x NOEC)]/2)*(Source: http://www.pbtprofiler.net/details.asp#fishchv)

In June 2001, the Joint Meeting of the Competent Authorities for the Implementation of Council Directive 67/548/EEC and Council Regulation (EEC) 793/93 agreed an interim strategy for management of PBT and vPvB substances[21]. The scope of the strategy was:

- *the development of PBT and vPvB criteria and testing strategies;*
- *the identification of potential PBT or vPvB substances using screening data and screening estimation techniques (QSARs) for substances for which relevant data is missing;*
- *the verification of PBT or vPvB properties by additional testing using the available legislative possibilities under Regulation (EC)793/93 and Directive 67/548/EEC;*
- *a qualitative evaluation of the sources, major emissions and pathways to the environment to establish the most appropriate and effective measures to minimise exposure to man and the environment; and*
- *the implementation of the necessary measures into Community legislation*[22].

In order to evaluate the 2,682 High Production Volume (HPV) substances identified for their potential PBT and vPvB characteristics, a Technical Committee for New and Existing Substances (TC NES) subgroup was formed by Member States representatives and European Chemical Bureau staff to check whether the substances fulfils the criteria to be classified as PBT/vPvB. One hundred and twenty seven substances were analysed; the results are presented in Figure 6.1 and Table 6.6.

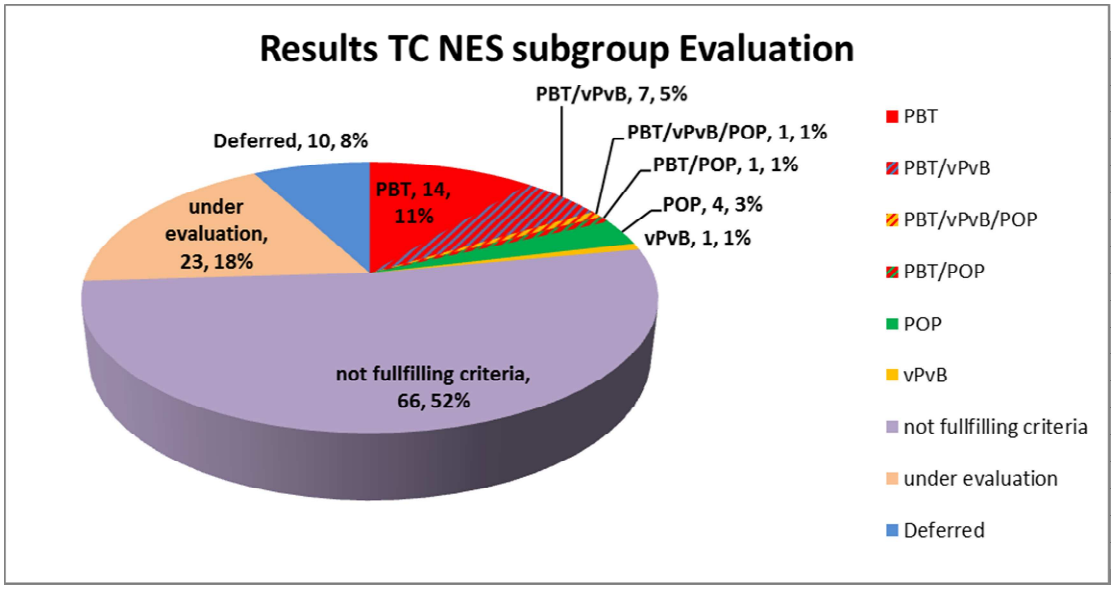

Figure 6.1: Results of the TC NES PBT subgroup evaluation

21 Doc. ENV/D/432048/01, NOTIF/36/2001.

22 http://esis.jrc.ec.europa.eu/index.php?PGM=pbt

Table 6.6: Results of the TC NES PBT subgroup Evaluation	
Substance Evaluation	**No. of substances**
Fulfilling PBT criteria	14
Fulfilling PBT and vPvB criteria	7
Fulfilling PBT and vPvB and POP criteria	1
Fulfilling PBT and POP criteria	1
Fulfilling POP criteria	4
Fulfilling vPvB criteria	1
Not fulfilling criteria	66
Under evaluation	23
Deferred	10
Total	**127**

Of the ten substances for which a conclusion was deferred (mainly because the substances were of no interest due to zero or low volumes being placed on the market), for hexachlorocyclopentadiene (CAS number 77-47-4) it was concluded that the pure substance does not fulfil the B criterion and consequently cannot be considered a PBT substances. However, commercial hexachlorocyclopentadiene may contain hexachlorobuta-1,3-diene (CAS number 87-68-3) and hexachlorobenzene as impurities, both classified as persistent organic pollutant (POP) subject to Regulation (EC) No. 850/2004[23].

Moreover, for the 23 substances that were listed as "under evaluation", the evaluation was actually suspended due to REACH coming into force and the fact that further evaluation would have to take place under its framework. For tetrabutyltin (CAS number 1461-25-2), however, it was concluded that it can be considered as a PBT substance and as a substance forming a PBT substance (tributyltin). Also the technical grade tetrabutyltin was considered as *a substance containing a PBT substance as impurity*[24]. For extracts (petroleum), heavy paraffin distillate solvent (CAS number 64742-04-7) was concluded as fulfilling the PBT/vPvB criteria, but the final PBT categorisation, since it is an UVCB substance, is dependent on guidance development for substances containing PBT or vPvB constituents[25].

In the Community Rolling Action Plan (CoRAP), 90 substances are listed for evaluation by the Member States Competent Authorities under Art. 44-48 of REACH.

23 ECB (2008): TC NES subgroup on identification of PBT and vPvB substances, results of the evaluation of the PBT/vPvB properties of Hexachlorocyclopentadiene, PBT Working Group – PBT List No. 108, available at Internet site: http://esis.jrc.ec.europa.eu/doc/PBT-evaluation/PBT_sum108_CAS_77-47-4.pdf

24 ECB (2008): TC NES subgroup on identification of PBT and vPvB substances, results of the evaluation of the PBT/vPvB properties of tetrabutyltin, PBT Working Group – PBT List No. 88, available at Internet site: http://esis.jrc.ec.europa.eu/doc/PBT-evaluation/PBT_sum088_CAS_1461-25-2.pdf

25 ECB (2008): TC NES subgroup on identification of PBT and vPvB substances, results of the evaluation of the PBT/vPvB properties of extracts (petroleum), heavy paraffin distillate solvent, PBT Working Group – PBT List No. 111, available at Internet site: http://esis.jrc.ec.europa.eu/doc/PBT-evaluation/PBT_sum111_CAS_64742-04-7.pdf

Twenty five of these substances are listed as "suspected PBT", three as "suspected PBT/vPvB" and one as "suspected vPvB"[26].
The United States Environmental Protection Agency (US EPA) reports under its Toxic Release Inventory (TRI) Programme[27] sixteen PBT substances and four PBT chemical compound categories, of which just one substance was identified by the TC NES PBT subgroup (hexachlorobenzene). The four categories include:

- dioxin and dioxin-like compounds;
- Lead compounds;
- Mercury compounds;
- Polycyclic aromatic compounds (PACs).

Table 6.7 shows the sixteen substances identified by the TRI Programme which are subject to special requirements for reporting if manufactured in quantities above a specified threshold.

Table 6.7: TRI PBT Chemical List

Chemical List	CAS Number
Aldrin	309-00-2
Benzo(g,h,i)perylene	191-24-2
Chlordane	57-74-9
Heptachlor	76-44-8
Hexachlorobenzene	118-74-1
Isodrin	465-73-6
Lead	7439-92-1
Mercury	7439-97-6
Methoxychlor	72-43-5
Octachlorostyrene	29082-74-4
Pendimethalin	40487-42-1
Pentachlorobenzene	608-93-5
Polychlorinated biphenyl (PCBs)	1336-36-3
Tetrabromobisphenol A	79-94-7
Toxaphene	8001-35-2
Trifluralin	1582-09-8

It has to be noted that Annex XIII of REACH cannot be applied to lead and mercury, since they are not organic substances; but it could be applied to lead compounds and mercury compounds when these are organometallic (*any member of a class of substances containing at least one metal-to-carbon bond in which the carbon is part of an organic group*)[28].

Many of the substances listed as PBT by the US EPA are also in the list of POPs under the Stockholm Convention, presented in Table 6.8.

26 ECHA (2012): Community Rolling Action Plan (CoRAP), European Chemical Agency. Available at Internet site: http://echa.europa.eu/documents/10162/13628/corap_2012_en.pdf

27 http://www.epa.gov/tri/trichemicals/pbt%20chemicals/pbt_chem_list.htm

28 http://www.britannica.com/EBchecked/topic/432186/organometallic-compound

Table 6.8: POPs under the Stockholm Convention	
Substance	**CAS number**
Aldrin	309-00-2
Chlordane	57-74-9
DDT	50-29-3
Dieldrin	60-57-1
Endrin	72-20-8
Heptachlor	76-44-8
Hexachlorobenzene	118-74-1
Mirex	2385-85-5
Toxaphene	8001-35-2
Polychlorinated biphenyls (PCB)	1336-36-3
Polychlorinated dibenzo-p-dioxins	Several entries
Polychlorinated dibenzofurans	Several entries
Alpha hexachlorocyclohexane	319-84-6
Beta hexachlorocyclohexane	319-85-7
Chlordecone	143-50-0
Hexabromobiphenyl	36355-01-8
Hexabromobiphenyl ether and heptabromodiphenyl ether	68631-49-2
Lindane	58-89-9
Pentachlorobenzene	608-93-5
Perfluorooctane sulfonic acid, its salts and perfluorooctanesulfonyl fluoride	1763-23-1
Technical endosulfan and its related isomers	115-29-7; 959-98-8 and 33213-65-9
Tetrabromodiphenyl ether and pentabromodiphenyl ether (commercial pentabromodiphenyl ether)	40088-47-9 32534-81-9
Hexabromocyclododecane*	3194-55-6
Short-chained chlorinated paraffins*	85535-84-8
Chlorinated naphthalenes*	70776-03-3
Hexachlorobutadiene*	87-68-3
Pentachlorophenol*	87-86-5
Note: * Proposed for listing under the Convention and currently under review.	

The OSPAR List of Substances of Possible Concern was adopted in 2002 and the initial selection contained around 400 substances, believed to potentially fulfil the criteria for PBT. Afterwards, a number of substances which do not meet the full P,B and T criteria but were considered to give rise to a similar level of concern were added to the list[29]. The list was conceived to be dynamic, as new information become available it would be updated, resulting in some substances being dropped from the list and others added. The list is divided into four sections:

- *Section A: Substances which warrant further work by OSPAR because they do not meet the criteria for Sections B – D and substances for which, for the time being, information is insufficient to group them in Sections B – D;*
- *Section B: Substances which are of concern for OSPAR but which are adequately addressed by EC initiatives or other international forums;*

[29] OSPAR (2002): OSPAR List of Substances of Possible Concern, Reference number 2002-17.

- *Section C: Substances which are not produced and/or used in the OSPAR catchment or are used in sufficiently contained systems making a threat to the marine environment unlikely;*
- *Section D: Substances which appear not to be "hazardous substances" in the meaning of the Hazardous Substances Strategy but where the evidence is not conclusive.*[30]

There are also three sub-lists of substances, one listing the prioritised substances (Priority Action list), one listing the substances removed from the List of Substances of Possible Concern (LSPC) and one listing the substances removed from the Priority Action List.

Currently, Section A lists 142 substances (including among them 22 pharmaceuticals and 5 hormones, not covered by REACH), section B lists 99 substances (including two pharmaceuticals), section C lists 28 substances (including one hormone) and section D just one pharmaceutical. The Priority Action list contains 29 substances (including one metallic compound and one pharmaceutical). As new information became available, 79 substances were removed from the LSPC and eight from the Priority Action list (but which are still in the LSPC).

As noted above, in the light of the developments under the Water Framework Directive and the REACH Regulation, the selection and prioritisation of substances under the OSPAR Convention has been put on hold[31].

The above analysis suggests that there are over 100 known PBT/vPvB substances at present out of the total set of substances.

The issue of concern here is how many unknown PBT/vPvB substances there may be currently on the market in the EU. A recent paper by Strempel *et al* (2012)[32] tried to identify PBT substances among the chemicals on the EU market.

The first step was to set up a database of CAS and SMILE[33] codes, merging the EINECS, SMILECAS[34] and ELINCS database and removing the incorrect CAS and SMILE codes. The merged database consisted of 137,257 entries, which after correction resulted in a database of 127,281 entries. A further refining was obtained removing inorganic, ionic and metallorganic chemicals as well as chemicals for which

30 http://www.ospar.org/content/content.asp?menu=00950304450153_000000_000000

31 http://www.ospar.org/content/content.asp?menu=01460304880000_000000_000000

32 Strempel *et al* (2012): Screening for PBT Chemicals among the "Existing" and "New" Chemicals of the EU, *Environ. Sci. Technol.*, 2012, 46 (11), pp 5680-5687.

33 Simplified Molecular Input Line Entry System (source: http://www.epa.gov/ncct/dsstox/MoreonSMILES.html)

34 http://www.srcinc.com/what-we-do/product.aspx?id=135

the models being used could not return a credible/reliable prediction[35], resulting in a database with 96,530 entries.

The second step was to define a PBT score as the sum of three subscores (equally weighted) identified by applying the REACH thresholds. A PBT score of 1.0 identifies a potential PBT substance.

In the search for valid information about persistency, bioaccumulation and toxicity, the authors noted that there is a very important lack of data: information on only 222 substances about half-life degradation were found (using the BIODEG database[36]); BCF values were found for 1,213 substances and K_{ow} values for 1,213 substances (CHEMFATE database[37], BCF gold standard database[38] and others); aquatic toxicity data (acute effect concentrations in daphnia and fish) were found for 2,245 substances (ECOTOX database[39] and others).

The property estimation methods applied were:

- BIOWIN3 for persistency;
- BCFBAF for bioaccumulation;
- ECOSAR for aquatic toxicity[40].

A PBT score of 1.0 (identifying potential PBT substances) was found for 3.5% of the substances in the database, equal to 3,404 substances. A sensitivity analysis for the uncertainty factors of the P, B and T properties was conducted, resulting in the definition of an upper bound of 13,050 potential PBT substances and a lower bound of 254. The most important driver for such uncertainty is linked to the data about persistency.

On the basis of the results, the authors spelled out the chemical structures found in the PBT class:

- *Chlorinated, brominated aromatic systems: benzenes, naphthalenes, biphenyls, diphenylethers, dibenzodioxins and –furans;*
- *Chlorinated, brominated (cyclo-)aliphatic compounds;*
- *Highly branched alkyl substances;*
- *Aromatic substances with several highly branched alkyl, ether or tertiary amine groups;*

35 20,854 inorganic and ionic substances (as prescribed in Annex XIII to REACH) and metallorganic substances (that should have been considered); 8,233 subs for which the models used cannot return a credible result (MW>1,000; or BIOWIN3 uses MW only; or Epi Suite reports SMILES error; or structure contains epoxide, peroxide); 1,664 substances with outliers in estimated values.

36 http://www.srcinc.com/what-we-do/databaseforms.aspx?id=382

37 http://www.srcinc.com/what-we-do/databaseforms.aspx?id=381

38 http://ambit.sourceforge.net/euras/

39 http://cfpub.epa.gov/ecotox/

40 http://www.epa.gov/oppt/exposure/pubs/episuite.htm

- *Per- and polyfluorinated alkyl substances;*
- *PAHs;*
- *Combinations of all these elements*[41].

Considering a population of 2,659 High Production Volume Chemicals (HPVCs), 2.2% were identified by the screening with this representing 58 potential PBT HPVCs[42]. Of these 58 substances, 24 are related to heavy fractions of petroleum (as lubricating oils), with the remaining thirty-four chemicals belonging to different classes:

- *Several compounds used as antidegradants (UV absorbers) in synthetic rubber;*
- *Several fluorinated, chlorinated and brominated compounds;*
- *Highly branched alkyl compounds.*

Screening 2,825 substances in the ELINCS database, 5.1% were found to be potential PBT substances (that is 142).

The authors concluded that, using a prudential estimate of 2% of chemicals as being potential PBTs, around 3,000 potential PBT substances are present on the world market[43]. Moreover, they called for further research on more and better degradation data and noticed that "new" chemicals are not going towards the desired "green chemistry". It should be noted though that in their screening exercise the authors removed all the organo-metal compounds, while Annex XIII also applies to these chemicals.

Another paper by the same research group from the Institute for Chemical and Bioengineering of the ETH Zurich tries to identify how many persistent organic pollutants are present on the markets[44].They used the criteria defined in the Stockholm Convention about persistence, bioaccumulation and long-range transport potential and the toxicity criterion from REACH. Screening for 93,144 organic chemicals they found 510 potential POPs beyond the 22 already covered by the Convention (with a lower bound of 190 substances and a higher bound of 1,200 substances due to uncertainty), of which 98% are halogenated chemicals. Moreover, ten of the substances identified as potential POPs are produced in high volumes and 249 were pre-registered under REACH.

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41 Scheringer *et al* (2012): Identifying Persistent, Bioacummulative and Toxic Chemicals among the Chemicals on the EU Market, presentation for Norman Workshop on "Emerging Contaminants in the Aquatic Environment" held in Oslo, Norway on March 1-2, 2012.

42 It has to be noted that they repeated the exercise done by the ECB in 2002, with a very similar population of substances (2,659 instead of 2,682), finding less than half potential PBT substances.

43 Confirming the findings of the Danish EPA study, estimating around 2% of substances in the EINECS database as potentially PBT substances. Source: Danish EPA (2001): Report on the Advisory list for selfclassification of dangerous substances, Environmental Project no. 636, 2001, available at Internet site: http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publications/2001/87-7944-694-9/html/default_eng.htm).

44 Scheringer*et al* (2012): How many persistent organic pollutants should we expect?,*Atmospheric Pollution Research* 3 (2012) 383-391.

Howard and Muir tried instead to identify new persistent and bioaccumulative organics among chemicals in commerce[45]. Screening a database of 22,263 chemicals in commerce obtained merging the Canadian Domestic Substance List (DSL)[46] and the US EPA Toxic Substances Control Act Inventory Update Rule database, they found 610 substances probably fulfilling the persistency and bioaccumulative screening criteria[47].

Another recent paper by the UK Environment Agency[48] screened 7,829 Low Production Volume (LPV) substances (manufactured in the range 10-1,000 tonnes/year) from the ESIS database for PBT/vPvB criteria, finding 184 potential PBT/vPvB substances. The approach followed was the application of a QSAR model (EPI SUITE^{TM}) but without expert judgement of the raw data.

Table 6.9 summarises the findings of the different studies.

Table 6.9: Results of the PBT screening studies

Study	Screening for	Population	Result	Percentage
ECB (2002)	Potential PBT/vPvB/POP	2,682	127	4.7%
	Actual PBT/vPvB/POP	127	28	22%
Strempel*et al* (2012)	Potential PBT	96,530	3,404	3.5%
	Potential PBT	2,659*	58	2.2%
	Potential PBT	2,825**	142	5%
Scheringer*et al* (2012)	Potential POP	93,144	510	0.5%
Howard and Muir (2010)	Potential P and B	22,263	610	2.7%
Brooke and Burns (2010)	Potential PBT	7,829	184	2.3%

Notes:
** HPV substances only;*
*** only substances in ELINCS database.*

It must be noted that the only study that was followed by an in-depth expert assessment of the raw data was the work carried out by the ECB (2002), which identified around 20% of the substances with potential PBT/vPvB characteristics as being actual PBT/vPvB substances.

Applying a prudential 2% to a total substance population of 150,000, it is assumed that a screening for potential PBT/vPvB would identify around 3,000 substances. If it is further assumed that only 20% of these would be found to be a PBT/vPvB based on the same ratio as found by the ECB when actual data are available, then this suggests a total of 600 substances.

45 Howard and Muir (2010): Identifying New Persistent and Bioaccumulative Organics among Chemicals in Commerce, *Environ. Sci. Technol.* 2010, 44, 2277-2285.

46 A list of 3,059 UVCB substances.

47 Identified by using the US EPA EPISuite software and expert judgement.

48 Brooke and Burns (2010): Environmental prioritisation of low production volume substances under REACH: PBT screening, Environment Agency, Bristol. Available at Internet site:

http://cdn.environment-agency.gov.uk/scho0210brvh-e-e.pdf

Based on these same ratios and an assumed substance population of 17,500 to be registered only in quantities between 1 to 10 tonnes, 350 potential PBT/vPvB substances would be screened by the application of the different QSAR methods currently available, and 70 would be identified as actual PBT/vPvB substances by in-depth expert judgment, of which 28 would also fulfill the criteria for vPvB classification.

In order to estimate the ratio between PBT and vPvB, the results from ECB (2002) can also be used. Here, 23 PBT substances were identified and nine vPvB substances were found. This implies a ratio of 23 to 9 (or 1 to 0.4) PBTs to vPvB may be identified in the future.

7. OPTIONS DEVELOPMENT FOR 1 TO 10 TONNE SUBSTANCES

7.1 Introduction

Different options for the registration of 1 to 10 tonne substances have been considered in the past. During the passage of REACH from White Paper (COM, 2001) to final regulation, there were several iterations of discussions around various options for this set of substances. For each iteration, an analysis of the associated costs (and benefits) was carried out with a view to identifying which combination of information requirements and associated exposure and safety assessments was likely to represent the most cost-effective means of delivering REACH objectives. These analyses ultimately informed (in large part) the selection of the final requirements.

The past analyses (and associated conclusions) were, however, based on the limited amount of information that was available at that time, and information gaps were filled with (reasoned) assumptions and guestimates. With the passage of time, it is now possible to fill in some of these gaps or to improve the quality of the underlying data (e.g. using the improved information on the ability to generate data using read across and other methods as discussed in Section 5). This allows a refined analysis of the potential options for changing the provisions regarding 1 to 10 tonne substances.

As part of this study, we have developed a new model to enable the analysis of new options for 1 to 10 tonne substances. This new model is based on the same principles as that originally supplied to the European Commission but has been substantially rewritten to incorporate new information, data and other refinements and to enable an assessment of new options. The design of this model and key assumptions are described in the remainder of this section and the results are presented in subsequent sections.

7.2 Options for Changing Information Requirements

7.2.1 Overview

Section 4 set of this report set out the possible types of modifications that could be made to REACH as part of both increased and reduced information requirements on 1 to 10 tonne substances. Based on the material presented in those sections and the above discussion, we have defined the following baseline and options for changing requirements with regard to either increasing or reducing information requirements. These form the basis of the subsequent modelling and options appraisal.

7.2.2 The Baseline

Article 12 of the REACH Regulation sets out the information to be submitted depending on tonnage. This identifies that the technical dossier (referred to in Article 10(a)) "*shall include all physicochemical, toxicological and ecotoxicological*

information that is relevant and available to the registrant and as a minimum the following:

a) the information specified in Annex VII for non-phase-in substances, and for phase-in substances meeting one or both of the criteria specified in Annex III, manufactured or imported in quantities of one tonne or more per year per manufacturer or importer;

b) *the information on physicochemical properties specified in Annex VII, section 7 for phase-in substances manufactured or imported in quantities of one tonne or more per year per manufacturer or importer which do not meet either of the criteria specified in Annex III.*"

Annex III (as amended[49]) sets out two criteria for which registrants would have to provide information on all the Annex VII endpoints[50]:

"*(a) substances for which it is predicted (i.e. by the application of (Q)SARs or other evidence) that they are likely to meet the criteria for category 1A or 1B classification in the hazard classes carcinogenicity, germ cell mutagenicity or reproductive toxicity or the criteria in Annex XIII;;*

(b) substances:

i. with dispersive or diffuse use(s) particularly where such substances are used in consumer mixtures or incorporated into consumer articles; and

ii. *for which it is predicted (i.e. by application of (Q)SARs or other evidence) that they are likely to meet the classification criteria for any health or environmental hazard classes or differentiations under Regulation (EC) No 1272/2008*".

7.2.3 Options for the Modification of Information Requirements

In all, ten options in addition to the Baseline have been developed for this study, each altering the scope and scale of requirements. These include options for decreasing requirements as well as those for increasing. Options differ by the endpoints that are/are not included and by the screening of the substances on the basis of the prediction (by the application of (Q)SARs, read across or other evidence) of their classification as CMR or PBT or vPvB or for any other human health or environmental endpoint.

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49 Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (Text with EEA relevance) - Official Journal L 353 , 31/12/2008 P. 0001 - 1355

50 And in this case, further testing may then be required to fulfil the data gaps; where animal testing is required to meet Annex VII a testing proposal would be submitted to ECHA.

In terms of the data endpoints required, there are 5 overarching options (a number of which are also divided into sub-options):

- Option 1: no registration;
- Option 2: Annex VII physicochemical data plus other available data only;
- Option 3: all the Annex VII endpoints;
- Option 4: all the Annex VII endpoints plus some selected endpoints from Annex VIII (presented in Table 8.1);
- Option 5: all the Annex VIII endpoints.

In terms of the screening of the substances on the basis of their predicted properties, different sub-options were developed based on different decision rules and information requirements levels.

The options (and, for reference purposes, the baseline) are summarised below:

Baseline: where the application of (Q)SARs, read across or other evidence predicts that a substance may meet the criteria for the classification under category (1A or 1B) under carcinogenicity, germ cell mutagenicity or reproductive toxicity or for the identification of PBT/vPvB substances then data on all Annex VII endpoints must be provided (including the use of testing where there are data gaps). Where the substance has a dispersive or diffuse use(s) and the application of (Q)SARs, read across or other evidence predicts that a substance may meet any classification criteria for the health or environmental hazard classes or differentiations51 under the CLP Regulation, then full Annex VII data must be provided. In other cases, registrants would have to provide just the physicochemical data set out in Annex VII (from 7.1 to 7.14) without the requirement to gather and summarise available data on other endpoints.

- **Option 1 - No registration for substances manufactured or imported in quantities between 1 and 10 tonnes:** this option would exempt all the substances manufactured or imported in quantities below the 10 tonnes threshold from providing any information and has been developed to compare the costs savings and impacts on competitiveness and innovation with the baseline and the other options.

- **Option 2 - Annex VII physicochemical data only**: under this option the registrants would have to provide just the physicochemical data set out in Annex VII (from 7.1 to 7.14) without the requirement to gather and summarise available data on other endpoints. This would save the time costs to prepare study summaries or robust study summaries.

- **Option 3a - data on all Annex VII endpoints for hazardous substances**: registrants would have to gather and present in study summaries or robust study summaries all the available testing and non-testing data. If the application of

[51] Art. 2 Definition 33 of Regulation No. 1272/2008: "*differentiation means distinction within hazard classes depending on the route of exposure or the nature of the effects*".

(Q)SARs, read across or other evidence provides indication that the substances meet the criteria for classification as CMR or PBT or vPvB or any other human health and environmental endpoint, **disregarding their dispersive or non-dispersive and diffuse use(s) or not diffuse use(s)**, all the information on Annex VII endpoints should be provided, filling data gaps with reliable tests where relevant.

- **Option 3b - data on all Annex VII endpoints for all the substances**: the registrants would have to provide all the available data generated by tests, read across, QSARs and other evidence on all Annex VII endpoints and would have to fill the data gaps through testing, even in the case they do not meet any classification criteria for human health and environmental hazard classes.

- **Option 4a - data on all Annex VII endpoints plus selected endpoints from Annex VIII for hazardous substances**: under this option, all the available testing and non-testing data would have to be provided. If the application of (Q)SARs, read across or other evidence provides indication that the substances meet the criteria for classification as CMR or PBT or vPvB or any other human health and environmental endpoint, **disregarding their dispersive or non-dispersive and diffuse use(s) or not diffuse use(s)**, all the information on Annex VII endpoints **plus some selected endpoints from Annex VIII** should be provided, filling data gaps with reliable tests where relevant.

- **Option 4b - data on all Annex VII endpoints and selected endpoints from Annex VIII for all the substances**: all the information on the Annex VII endpoints plus some selected endpoints from Annex VIII would have to be provided, disregarding any human health and environmental classification found.

- **Option 4c - No registration for non-hazardous substances**: under this option, if a screening for M and R properties (based on existing data, read across and QSARs) provides an indication that the substances meet the criteria for classification as (C)MR, all the information on Annex VII endpoints plus some selected endpoints from Annex VIII should be provided, filling data gaps with reliable tests where relevant. If the result of the screening is negative, the substances would have not to be registered.

- **Option 4d - No registration for non-hazardous substances**: if a screening for M and R and PBT/vPvB properties (based on existing data, read across and QSARs) provides an indication that the substances meet the criteria for classification as (C)MR or PBT/vPvB, all the information on Annex VII endpoints plus some selected endpoints from Annex VIII should be provided, filling data gaps with reliable tests where relevant. If the result of the screening is negative, the substances would have not to be registered.

- **Option 5a - data on all Annex VIII endpoints for hazardous substances**: if the application of (Q)SARs, read across or other evidence provides indication

that the substances meet the criteria for classification as CMR or PBT or vPvB or any other human health and environmental endpoint, **disregarding their dispersive or non-dispersive and diffuse use(s) or not diffuse use(s),** all the information on Annex VIII endpoints should be provided, filling data gaps with reliable tests where relevant.

- **Option 5b - data on all Annex VIII endpoints for all the substances**: all the information on the Annex VIII endpoints would have to be provided, disregarding any human health and environmental classification found.

Table 7.1 (overleaf) provides the data requirements that would apply under the baseline in the case the criteria of Annex III are met, the information requirements for options 3b, 4b and 5b that apply to all the substances disregarding their hazardous/non-hazardous properties and the data requirements for 3a, 4a, and 5a in the case the criteria as CMR or PBT or vPvB or any human health and environmental endpoints for classification are met. When the result of the screening is negative, the registrants would have to provide just the physicochemical data listed in Annex VII (as for option 2), with the exception of 4c, where, as for option 1, no registration is required.

7.2.4 Content of Registration Dossiers

As noted above, the content of the registration dossier varies by option and, in the case of the increased provision of data options, by the properties and uses of the substance and the following triggers (individually or in combination of two or more):

1. Certain properties - such as CMR 1A and 1B, PBT/vPvB.
2. Any health or environmental hazard classes or differentiations under Regulation (EC) No 1272/2008.

The content of registration dossiers for all options and the baseline is based on the existing requirements for 1-10t and 10-100t substances summarised in Table 7.2. The costs applied in each case are discussed in Section 7.5.

Table 7.2: Parameters for Registration Requirements Considered

Baseline (Current 1 to 10 Tonne Substances)	**Increased Information Requirements (10 to 100 Tonne Substances)**
General	
Identity of the manufacturer/importer	Identity of the manufacturer/importer
Identity of the substance as specified in Annex VI	Identity of the substance
Molecular/structural formula	Molecular/structural formula
Composition	Composition
Hazards	
Classification & labelling	Classification & labelling
Any available existing information on physicochemical, human health or environmental properties. Study summaries where full report available	Any available existing information on physicochemical, human health or environmental properties. Study summaries where full report available
Physicochemical data from Annex VII.	Physicochemical data from Annex VII.

Table 7.2: Parameters for Registration Requirements Considered	
Baseline (Current 1 to 10 Tonne Substances)	**Increased Information Requirements (10 to 100 Tonne Substances)**
(Eco)toxicological data from Annex VII (for phase-in - only if meet Annex III criteria)	(Eco)toxicological data from Annex VII
N/A	(Eco)toxicological data from Annex VIII
Results of PBT/vPvB assessment	Results of PBT/vPvB assessment (based on more data)
Robust study summaries	Robust study summaries
PBT/vPvB assessment	PBT/vPvB assessment
N/A	Hazard Assessment for CSA
Use and Exposure	
Information on manufacture and use	Information on manufacture and use
Industrial use, professional use; and/or consumer use	Industrial use, professional use; and/or consumer use
Whether use can include; in closed system, resulting in inclusion into or onto matrix, non-dispersive and/or dispersive	Whether use can include; in closed system, resulting in inclusion into or onto matrix, non-dispersive and/or dispersive
Significant route(s) of exposure to humans and environment	Significant route(s) of exposure to humans and environment
Patterns of exposure	Patterns of exposure
Exposure Assessment (only where relying upon exposure based waiving)	Exposure Assessment (where relying upon exposure based waiving)
N/A	Exposure Assessment for CSA (if classified for endpoints set out in Article 14(4) or PBT/vPvB)
N/A	Exposure scenarios for all uses (where Exposure Assessment carried out)
Risk, Assessment, Management and Communication	
Guidance for safe use	Risk Characterisation for CSA (if classified for endpoints set out in Article 14(4) or PBT/vPvB)
N/A	Risk management measures for CSA (if classified for endpoints set out in Article 14(4) or PBT/vPvB)
N/A	CSA documented in CSR
Communication in the Supply Chain	
Guidance on safe use	Details of risk management measures
SDS (if classified for endpoints set out in Article 31 or PBT/vPvB or if SVHC on candidate list)	eSDS, including Exposure Scenarios and Risk Management Measures (if classified for endpoints set out in Article 31 or PBT/vPvB or if SVHC on candidate list)

Table 7.1: Test Endpoints for each Option													
Endpoint	**Test**	**Relevant CLP Classification**	**BL**	**Opt 1**	**Opt 2**	**Opt 3a**	**Opt 3b**	**Opt 4a**	**Opt 4b**	**Opt 4c**	**Opt 4c**	**Opt 5a**	**Opt 5b**
Human Health													
Annex VII 8.1. (3) Skin irritation/ corrosion	*In vitro* skin corrosion	Skin corrosive (1A, 1B & 1C)	X			X	X	X	X			X	X
Annex VII 8.1. (4) Skin irritation/ corrosion	*In vitro* skin irritation	Skin irritation (2)	X			X	X	X	X			X	X
Annex VIII 8.1.1. Skin irritation/ corrosion	*in vivo* skin irritation	Skin irritation (2)										X	X
Annex VII 8.2. Eye irritation	*In vitro* eye irritation	Serious eye damage/irritation (1 &2)	X			X	X	X	X			X	X
Annex VIII 8.2.1. Eye irritation	*In vivo* eye irritation	Serious eye damage/irritation (1 &2)										X	X
Annex VII 8.3. Skin sensitisation	*In vivo* LLNA	Skin sensitiser (1)	X			X	X	X	X			X	X
Annex VII 8.4.1. Mutagenicity	Prokaryote*: In vitro* gene mutation bacteria	Positive test	X			X	X	X	X	X	X	X	X
Annex VIII 8.4.2 Mutagenicity	Eukaryote: *In vitro* cytogenicity	Germ cell mutagenicity (2)						X	X	X	X	X	X
Annex VIII 8.4.3. Mutagenicity	Eukaryote: *In vitro* gene mutation	Germ cell mutagenicity (2)						X	X	X	X	X	X
Annex VII 8.5. Acute toxicity	Oral	Acute oral toxicity (1-4)	X			X	X	X	X		X	X	X
Annex VIII 8.5.2. Acute toxicity	Inhalation	Acute inhalation toxicity (1-4)										X	X

Table 7.1: Test Endpoints for each Option													
Endpoint	**Test**	**Relevant CLP Classification**	**BL**	**Opt 1**	**Opt 2**	**Opt 3a**	**Opt 3b**	**Opt 4a**	**Opt 4b**	**Opt 4c**	**Opt 4c**	**Opt 5a**	**Opt 5b**
Annex VIII 8.5.3. Acute toxicity	Dermal	Acute dermal toxicity (1-4)										X	X
Annex VIII 8.6.1. Repeat dose toxicity	Short term (1 route only)	Single target organ toxicity - repeated exposure (STOT RE 1 and 2)						X	X	X	X	X	X
Annex VIII 8.7.1. Reproductive toxicity	Screening for repro or developmental (OECD 421 or 422)	Reproductive toxicants (1B and 2)										X	X
Annex VIII 8.8.1. Toxicokinetics	Assessment of available information only	None										X	X
Environmental													
Annex VII 9.1.1. Aquatic Toxicity	Invertebrate - short-term	Hazardous to the aquatic environment (acute 1 & chronic 1-4)	X			X	X	X	X			X	X
Annex VII 9.1.2. Aquatic Toxicity	Algal - short-term	Hazardous to the aquatic environment acute (1)	X			X	X	X	X			X	X
Annex VIII 9.1.4. Aquatic Toxicity	STP: Activated sludge respiration inhibition	Hazardous to the aquatic environment acute (1)										X	X
Annex VIII 9.1.3. Aquatic Toxicity	Fish – short-term	Hazardous to the aquatic environment acute (1)										X	X

Table 7.1: Test Endpoints for each Option													
Endpoint	**Test**	**Relevant CLP Classification**	**BL**	**Opt 1**	**Opt 2**	**Opt 3a**	**Opt 3b**	**Opt 4a**	**Opt 4b**	**Opt 4c**	**Opt 4c**	**Opt 5a**	**Opt 5b**
Annex VII 9.2.1.1. Degradation	Biotic - Ready biodeg	Screening for vB in vPvB	X			X	X	X	X		X	X	X
Annex VII 9.2.1.1. Degradation	Biotic - Ready biodeg	Screening for B in PBT	X			X	X	X	X		X	X	X
Annex VIII 9.2.2.1. Degradation	Abiotic - Hydrolysis	Screening for vP (in vPvB)										X	X
Annex VIII 9.2.2.1. Degradation	Abiotic - Hydrolysis	Screening for P in PBT										X	X
Annex VIII 9.3. Fate and behaviour	Adsorption/ desorption[5]	Screening for vP (in vPvB)						X	X		X	X	X
Annex VIII 9.3. Fate and behaviour	Adsorption/ desorption[5]	Screening for P in PBT						X	X		X	X	X
PBT & vPvB assessment			X			X		X			X	X	

7.3 Methods and Data used to Analyse Options

7.3.1 Overview of the Modelling Approach

As noted in Section 7.1, a new model has been developed to analyse the options. Methodologically, this model draws on the original model that was developed and provided to the Commission. The new model has been substantially modified to account for new and updated information. The model itself has been designed to provide key performance data for each option including:

- the number of substances identified with previously unknown toxicological and ecotoxicological properties (and associated classifications);
- the number of already classified substances where additional classifications are found;
- the number of possible CMRs 1A and 1B (possible because Annex VII and VIII tests only allow identification of suspects) and possible PBT/vPvBs identified;
- the costs associated with read across, QSARs or other evidence;
- the costs associated with testing (where appropriate for the option);
- the costs of registration;
- the associated registration fees.

In simple terms, the model achieves this by using probabilities to generate virtual 1 to 10 tonne substances. Generating and analysing each virtual substance in turn, the toxicological/ecotoxicological profile and nature/use of each virtual substance is dictated by the probabilities assigned to each characteristic, where these have been drawn from the analyses presented in the earlier sections (with key assumptions re-presented here for convenience). The model then uses a series of further probabilities to model the extent to which the different options are able to identify these characteristics (particularly, those that may be of concern) and associated costs for each option. The model records the outcomes under each option for each virtual substance generated. These outcomes are then aggregated to the number of 1 to 10 tonne substances to provide results.

In addition to generating and recording performance data for each virtual substance under each option, the model also generates information on the registrants in terms of:

- the number of manufacturers/importers of the substance;
- the size of those companies (micro, small, medium and large); and
- whether the dossier is submitted jointly (or individually).

This information is used both to generate the appropriate registration fees and in subsequent analysis of impacts of costs on manufacturers and importers of different sizes.

Whilst the model user can determine how many virtual substances to analyse, as the model generates virtual substances using defined probabilities (many of which, such as PBT/vPvB, are very low), to fully capture all of the possible permutations, thousands of virtual substances must be generated and analysed. For this analysis

17,500 virtual substances have been generated for both the main scenario and for sensitivity analysis.

7.3.2 Key Assumptions

As noted above, the model draws on a number of data sources and that have been used to inform assumptions and probabilities to apply to 1 to 10 tonne substances. For clarity and transparency, these are briefly summarised in the sections below.

Numbers of Substances

It is assumed that 17,500 substances will be registered in the 1 to 10 tonnage band. This is drawn from JRC's 2003 estimates which, in turn, were used in RPA's 2006 assessment of CSA costs as part of the Technical Assistance Contract (TAC). This estimate takes into account the fact that some substances are likely to be withdrawn from the market due to the combination of low volume and low value (see also the original Business Impact Assessment (RPA, 2003)). It has to be noted that the list of substances registered by the 2010 deadline[52] and the list of substances identified by industry to be registered by 31 May 2013[53] validate the estimates produced so far.

Percentage of Substances that Have a Disperse/Diffuse Use

In work on CSAs for the TAC, it was assumed that between 20% and 40% of substances are used in wide dispersive uses (20% based on the Danish and Nordic Product Registers and 40% based on the Commission's previous estimates). The analysis provided below assumes a mid-value figure of 30%.

Probability that a Substance Reaches the Classification Threshold

As noted above, the model generates virtual substances, each with a probabilistically derived (eco)toxicological profile denoting whether or not the given virtual substance is likely to have properties linked to a given classification. The probabilities used for this purpose are drawn from the discussion in Section 6 on the percentage of substances with each classification, as set out in Table 6.3.

Probability of Substance Properties Being Identified for Classification

The accuracy of the test methods used to generate data for fulfilling the information requirements set out in Annexes VII and VIII, have been assessed, as described in Section 6 (see Table 6.4). From this assessment and expert judgement percentages of substances likely to be identified for classification were estimated, also set out in Tables 6.4.

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52 Published by ECHA, available from (http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances).

53 Published by ECHA, available from (http://echa.europa.eu/information-on-chemicals/registered-substances/identified-substances-for-registration-in-2013).

Carcinogenic, Mutagenic and Reproductive Toxins (CMRs)

In terms of CMR properties, as the analysis does not consider endpoints above those applicable to the 10-100 tonnage band (Annex VIII), the only tests available to provide information on these within the options are:

- Mutagenicity: Prokaryote: *In vitro* gene mutation bacteria;
- Mutagenicity: Eukaryote: *In vitro* cytogenicity;
- Mutagenicity: *In vitro* gene mutation; and
- Screening for reproductive or developmental toxicity (OECD 421 or 422).

Only the first of these (*in vitro* gene mutation bacteria) is present in Annex VII.

Test endpoints for carcinogenicity are missing from both Annexes VII and VIII (and hence the options and baseline). As a result, none of the options (nor the baseline) are capable of identifying any possible new carcinogens (i.e. those that are not already known about) and the analysis only considers new Ms and Rs.

In terms of possible mutagens and reproductive/developmental toxins, the analysis assumes that a positive result indicates the identification of a possible M and/or R. However, where a prokaryote *in vitro* gene mutation tests positive and eukaryote tests are negative, the substance is eliminated from suspicion of M characteristics.

Possible Persistent, Bioaccumulative and Toxic (PBT)/Very Persistent and Very Bioaccumulatyive (vPvB) Substances

As described above in relation to the other environmental and human health endpoints, the probability that a given substance will have properties that reach the threshold for classification against a specified endpoint is based on the percentage of substances known with each classification. The same basic approach has been applied in the case of PBT and vPvB substances where the analysis uses the following decision rules to identify a given virtual substance as a possible PBT/vPvB:

- if data suggests positive results for P and/or B and T (with no contradicting evidence suggesting not P or B or T), then the substance is identified as a possible PBT; and
- if data suggests vP and/or vB (with no contradicting evidence suggesting not vP or vB), then the substance is identified as a possible vPvB.

In relation to the probabilities used to derive estimates of the number of PBTs and vPvBs and generate virtual substances, the issue is more complex than for many of the other endpoints. Section 6.3 provided an overview of the literature and associated estimates of the percentage of substances with PBT (and/or vPvB) properties. Based on the work of Scheringer *et al* (2012) and others, that discussion concludes that screening for P, B and T is likely to identify that 2% of substances exhibit PBT characteristics. However, based on ECB (2002), it is further estimated that around 20% of the substances with potential PBT characteristics are actual PBT substances (i.e. 0.4% overall).

For the purpose of generating virtual substances for the model, it is necessary to derive probabilities that broadly describe the likelihood that a given substance is P, B and/or T. In earlier versions of the model it was simply assumed that the likelihoods of P, B and T were independent from one another. In practice, however, there are likely to be interrelationships between these characteristics (particularly between P and B characteristics). The existence of such interrelationships is easily demonstrated by the fact that independent probabilities assigned to P, B and T are unable to provide the probability distributions suggested by the work of Scheringer *et al* (2012), as provided in Table 7.2.

Here, for example, whilst one can derive different sets of independent probabilities for P, B and T that fit values for PBT3 (around 2%) or for non-PBT0 (around 60%) in Table 7.2, a single set of independent probabilities is unable to provide estimates consistent with both or with the distribution of the other variables (non-PBT2 and non-PBT1).

Table 7.2: Percentage of Substances identified with P, B and or T Characteristics through Screening

Characteristics	Description	Percentage of Substances identified through Screening (i.e probability)
PBT3	Substances exhibiting all three characteristics (PBT)	3.5% (the authors also suggest 2% as appropriate)
Non-PBT2	Substances with two of the three characteristics (i.e. PB only, PT only or BT only substances)	10.1%
Non-PBT1	Substances with one of the three characteristics (i.e. P only, B only, or T only substances)	26.1%
Non-PBT0	Substances with none of the three characteristics	60.3%

Further analysis suggests that a probability distribution similar to that of Scheringer *et al* (2012) can be derived if one assumes a link between P and B characteristics and an independent value for T. As discussed in Section 6, the probability of classification for T is given by a range of test endpoints that suggest that the overall probability of a possible T classification is around 0.21 (21%). Taking this and, from Scheringer *et al* (2012), the combined probability that PBT3 = 0.02 (2%) and non-PBT0 = 0.6 (60%) one can back-calculate the following:

- the probability that screening suggests that a substance will meet classification for B;
- for a substance meeting classification for B, the probability that screening suggests that a substance will also meet classification for P (termed P1); and
- for substances NOT meeting classification for B, the probability that screening suggests that a substance will meet classification for P (termed P0).

The resulting calculated probabilities for screening are provided in Table 7.3.

Table 7.3: Calculated Probabilities	
Variable	**Calculated Probability Values**
T - Probability of T	0.210
B - Probability of B	0.168
P1 - For substance meeting B, probability of P	0.567
P0 - For substance NOT meeting B, probability of P	0.083

The derived probabilities given in Table 7.3 have been used to calculate values for non-PBT2 and non-PBT1 outcomes and, thus, provide a means to cross check values with the estimates of Scheringer *et al* (2012). Figure 7.1 provides a tree diagram describing all combinations and associated combined probabilities and Table 7.4 compares our calculated values with those of Scheringer *et al* (2012).

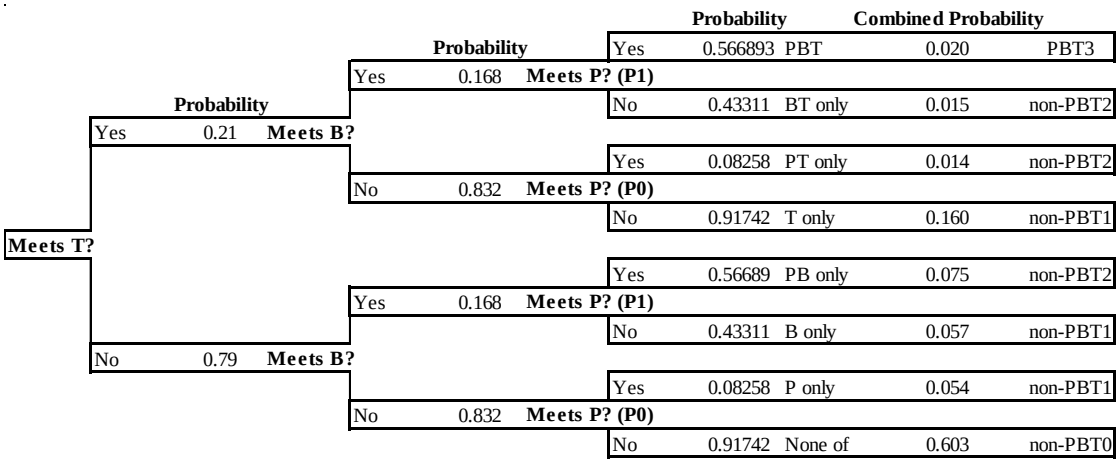


Figure 7.1: Diagram with associated combined probabilities

Table 7.4: Comparison of Calculated Probability Values with Those of Scheringer *et al* (2012)		
	Calculated Combined Probability	**Estimates from Scheringer *et al* (2012)**
PBT3	2.00%	3.5% or "around 2%"
non-PBT2	10.49%	10.10%
non-PBT1	27.21%	26.10%
non-PBT0	60.30%	60.30%

As can be seen from Table 7.4, the calculated probabilities provide a reasonable approximation of the outcome of screening for the purposes of generating virtual substances and of the numbers of substances identified by screening as potentially being PBT. As noted earlier, however, screening will tend to overestimate the number of actual PBT substances and, based on ECB (2002), it is further estimated that around 20% of the substances with potential PBT characteristics are actual PBT substances (i.e. 0.4% overall). Accordingly, the actual and possible numbers of PBTs predicted in the model are provided in Table 7.5.

Table 7.5: Numbers of Possible and Actual PBTs		
	Total Substances	**1-10t Substances**
Number of Substances	150,000	17,500
Number identified as Possible PBT by Screening	3,000	350
Number of actual PBTs	600	70

In terms of vPvBs, as noted in Section 6.3, results from ECB (2002) imply a ratio of 23 to 9 (or 1 to 0.4) PBTs to vPvB may be identified in the future. The number of vPvBs can be derived from the above calculations in relation to P and B characteristics (since all vPvB substances will satisfy P and B). As is suggested by the tree diagram in Figure 7.1, the calculated combined likelihood of P and B substances identified by screening is 0.075 (7.5%)[54]. As such, around 10% of the substances identified as P and B (7.5%) would be identified as vPvB by screening (where this provides a ratio of PBT to vPvB consistent with the 1:0.4 = 2.6 given above). The numbers of vPvBs calculated in this way are provided in Table 7.6.

Table 7.6: Numbers of Possible and Actual vPvBs		
	Total Substances	**1-10t Substances**
Number of Substances	150,000	17,500
Number identified as Possible vPvB by Screening	1,129	132
Number of actual vPvBs	226	26
Number of substances fulfilling the vPvB criteria but not the PBT criteria	25	3

Substances Already Having Data on Some/All Endpoints

As previously discussed, some substances will already have some data in relation to endpoints, some will have all data and others will have none. The 2006 analysis drew numbers from the 2006 ECB spreadsheet assumptions on the percentage of substances with a complete data set. These, in turn, were mainly drawn from the original Business Impact Assessment of the White Paper (which also drew on data from an ECB and a Danish Study). These assumed that 17% of substances had a complete set of data (and others had none).

- In this analysis, we have altered figures where this has been loosely informed by consideration of data on actual percentages of the higher tonnage band substances having data. Here, we have assumed the following:
- 10% of the 1 to 10 tonne substances have data on skin corrosion, skin irritation, acute toxicity (oral), and aquatic invertebrate toxicity;

[54] Whilst one could also include the PBT substances (as some of these may also be vPvB) it is assumed that these would be classified as PBT as opposed to vPvB.

- 20% of the 1 to 10 tonne substances have data on all Annex VII endpoints;
- 30% of the substances with data on Annex VII endpoints also have data on all Annex VIII endpoints; and
- the remainder (70%) have no data on human health and environmental endpoints.

Application of Read Across

Where no existing data are available for one or more endpoints, for the appropriate option/situation, the analysis assumes that information is sought from read across. This may be optimistic in the case of small producers who lack skill in the use of read across methods and who may therefore decide to have additional testing undertaken, although they could also contract external consultants to carry out read across together with the use of QSARs. The likelihood that information can be used to fulfil data requirements is given by a series of probabilities connected to each endpoint. These were provided in Table 5.6.

In terms of cost, it has been assumed that the cost per read across endpoint is between €100 and €500. When assigning a cost to a given virtual substance, the model randomly generates a cost within this range.

Application of QSARs

Where read across is unsuccessful, the analysis assumes that QSARs are applied to missing data endpoints. As discussed in Section 5, the successful application of QSARs differs from one endpoint to another and depends on a combination of the domain and the performance for different endpoints. The tools and science behind QSARs are developing and estimates of present and future QSAR domain and performance have been provided in Table 5.7. Owing to the timing of registration for 1 to 10 tonne substances, those values given in Table 5.7 for 2018 have been applied.

For this analysis, it has been assumed that where performance is poor for a given endpoint, QSARs are not applied as their results are insufficiently robust (and their regulatory acceptance is also, therefore, low). In terms of domain, each endpoint has been grouped into linked domain groups to which probabilities have been attached separately. In the case of linked domain groups, the model assumes that in all cases the probability that a substance is within the domain for a given QSAR (and hence will deliver a QSAR of the performance indicated) is as follows:

- 'poor' domain - 10%
- 'fair' domain - 40%
- 'good' domain - 70%

The model does have the functionality to allow these probabilities to be varied to reflect different probabilities for the different linked domain groups. At present, however, the probabilities are undifferentiated (and as above).

On the basis of discussions with laboratories providing QSAR information, the costs of applying QSARs is assumed to be between €500 and €1,500. When assigning a

cost to a given virtual substance, the model randomly generates a cost within this range.

Clearly, application of a QSAR approach may not always deliver useful information and, in many cases, the provider of QSAR services may identify this 'up front' and, hence, no costs will be incurred. However, providers may not always identify this or be able to identify this until the QSAR analysis is completed. As such, for this analysis it has been assumed that 30% of substances will incur the full cost of running inappropriate/ineffective QSARs.

7.3.3 Assumptions Applicable to Full Testing

As discussed earlier, data is gathered through full testing in situations where:

- there is no existing data for a required endpoint; and
- read across cannot be applied for a required endpoint; and
- read across and QSARs cannot be applied for a required endpoint.

In these cases a test is carried out. The assumed costs of these tests are provided in the Table 6.10 below. In addition, there is a chance that a single given test may not be able to identify a property/threshold of concern. As such, the model accounts for these by assigning a probability that a given test for a given endpoint would successfully identify the substance as having a property of concern (if it has one). These probabilities are also provided in Table 7.7.

Table 7.7: Test Costs and Probability that a Test would identify a Classification

Endpoint	Test	Relevant CLP Classification	Probability that a Test Would Identify a Classification[1]	Test Cost Applicable
Skin irritation/ corrosion	*In vitro* skin corrosion	Skin corrosive (1A, 1B & 1C)	95%	€ 1,500
Skin irritation/ corrosion	*In vitro* skin irritation	Skin irritation (2)	80%	Covered by the above
Skin irritation/ corrosion	*in vivo* skin irritation	Skin irritation (2)	95%	€ 1,600
Eye irritation	*In vitro* eye irritation	Serious eye damage/irritation (1 &2)	80%	€ 1,350
Eye irritation	*In vivo* eye irritation	Serious eye damage/irritation (1 &2)	95%	€ 1,300
Skin sensitisation	*In vivo* LLNA	Skin sensitiser (1)	85%	€ 4,000
Mutagenicity	Prokaryote*: In vitro* gene mutation bacteria	Positive test	60%	€ 3,200
Mutagenicity	Eukaryote: *In*	Germ cell mutagenicity	90%	€ 14,000

Table 7.7: Test Costs and Probability that a Test would identify a Classification				
Endpoint	**Test**	**Relevant CLP Classification**	**Probability that a Test Would Identify a Classification[1]**	**Test Cost Applicable**
	vitro cytogenicity	(2)		
Mutagenicity	Eukaryote: *In vitro* gene mutation	Germ cell mutagenicity (2)	90%	€ 12,000
Acute toxicity	Oral	Acute oral toxicity (1-4) & STOT SE (1-3)	100 %	€ 1,500
Acute toxicity	Inhalation	Acute inhalation toxicity (1-4) & STOT SE (1-3)	75%	€ 12,000
Acute toxicity	Dermal	Acute dermal toxicity (1-4) & STOT SE (1-3)	100 %	€ 2,200
Repeat dose toxicity	Short term (1 route only)	Single target organ toxicity - repeated exposure (STOT RE 1 and 2)	85%	€ 50,000
Reproductive toxicity	Screening for repro or developmental (OECD 421 or 422)	Reproductive toxicants (1B and 2)	60%	€ 110,000
Toxicokinetics	Assessment of available information only	None	-	€1,000
Environmental				
Aquatic Toxicity	Invertebrate - short-term	Hazardous to the aquatic environment (acute 1 & chronic 1-4)	50 % for Acute 1; 5 % - for Chronic 1-4	€ 4,500
Aquatic Toxicity	Algal - short-term	Hazardous to the aquatic environment acute (1)	50%	€ 4,600
Aquatic Toxicity	STP: Activated sludge respiration inhibition	Hazardous to the aquatic environment acute (1)	50%	€ 2,500
Aquatic Toxicity	Fish – short-term	Hazardous to the aquatic environment acute (1)	70%	€ 4,300
Degradation	Biotic - Ready biodeg	Screening for vB in vPvB	N/A	€ 4,500
Degradation	Biotic - Ready biodeg	Screening for B in PBT	N/A	
Degradation	Abiotic - Hydrolysis	Screening for vP (in vPvB)	N/A	€ 7,000

Table 7.7: Test Costs and Probability that a Test would identify a Classification				
Endpoint	**Test**	**Relevant CLP Classification**	**Probability that a Test Would Identify a Classification[1]**	**Test Cost Applicable**
Degradation	Abiotic - Hydrolysis	Screening for P in PBT	N/A	
Fate and behaviour	Adsorption/ desorption[5]	Screening for vP (in vPvB)	N/A	€ 3,200
Fate and behaviour	Adsorption/ desorption[5]	Screening for P in PBT	N/A	
Note 1: See Table 6.4 for justification of these percentages. *Source*: Test costs are based on up-dated information available from Cefic, together with additional information collected from EU testing houses for the purposes of this study.				

7.3.4 Registration Costs

In previous studies, registration costs have been based on the number of estimated person-days assumed to be required to complete the following registration components:

- administration (including costs for updates and communication);
- exposure assessment;
- study summaries;
- safety data sheet (SDS);
- proposals for animal testing; and
- PBT assessment.

Table 7.8 provides the assumed costs (per substance) associated with each of these components, where these vary depending on classifiable endpoint. The figures quoted in Table 7.8 are built up from previous estimates underlying the Commission's Extended Impact Assessment, the Revised BIA, the CSES (2012) study and RPA's work in 2006 under the Technical Service Contract for DG Enterprise.

As shown in Table 7.8, administrative costs including general information exchange requirements along the supply chain and the development and handling of SDS vary depending on whether a substance has a dispersive/diffuse use, as this makes certain assessments such as exposure assessment more complex and the information needs to be exchanged with more entities.

It is interesting to note that the recent study carried out by CSES (2012) for DG Enterprise found total costs per registration for mainly high production volume substances registered to date to be mainly between €50,000 and €100,000, and 70% in the broader range of €25,000 to €250,000 (CSES, 2012)[55]. The main cost drivers for registration were identified as:

[55] It is of note that these figures are not dissimilar to the estimates generated for the Revised Business Impact Assessment (RPA, 2003), with an estimated total cost excluding fees of a registration for a

- ECHA fees, which often represented 50% or more of the total costs, with the standard fees for the registration of a substance above 1000 tonnes being between €23,250 and €31,000;
- access to data-studies/Letters of Access (€5,000 to €10,000 for a simple substance);
- and human resources (not stated).

It is important to recognise that these figures apply to substances registered in 2010 and thus relate to substances which had a significant amount of available information. Furthermore most of these substances were registered as part of a joint submission, with every registration having several members. For 1 to 10 tonne substances, it is much more likely that a significant proportion of substances will only be registered by a single registrant, with the full costs then borne by that registrant.

Table 7.9 shows the fees for substances in the range of 1 to 10 tonnes. It has to be noted that "*the fee needs not be paid for a registration of a substance in a quantity of between 1 and 10 tonnes where the registration dossier contains the full information in Annex VII*"[56].

The CSES (2012) estimates also include the cost of obtaining data, with this including the costs of obtaining a letter of access for tests carried out prior to the introduction of REACH (e.g. 54% of the data for endpoints requiring *in vivo* tests (generally the most expensive tests) came from tests carried out prior to the introduction of REACH, with higher for some test endpoints, e.g. 85% for acute toxicity, 78% for skin irritation and 75% for eye irritation (ECHA, 2011)).

For substances registered at greater than 10 tonnes, dossiers may be accompanied by test proposals. In these cases, there may therefore be additional costs of up-dating a dossier following the receipt of test results. As no further testing is required for substances at less than 10 tonnes, unless they become subject to evaluation, then there should be no additional up-date requirements as a matter of course. On this basis, we have not included any further costs associated with such changes to the original registration dossier. This may mean that we have under-estimated the costs associated with the requirement to register substances in this tonnage band. However, to include some additional cost for up-dates across all or a significant proportion of these substances may also result in an overestimation of registration costs.

dangerous substance being €60,150 per registrant for a substance at 1,000 tonnes or higher. The Revised BIA figure is low, though within the context of the total costs across all registrants including SIEF and consortia costs, with only a further €50,000 added on for these for any given high volume substance (although this analysis was also modified in 2006 to account for OSOR requirements).

[56] Article 74(2) of REACH.

Table 7.8: Different cost types incurred for the registration of a substance (where X denotes where a cost is incurred under an option and (X) denotes where the cost is dependent on the outcome of screening for properties of concern according to the decision rules applied under each option)

	Variable Factors	Assumed Cost	BL	Opt 2	Opt 3a	Opt 3b	Opt 4a	Opt 4b	Opts 4c/d	Opt 5a	Opt 5b
Administration: SIEF communication, downstream user communication, submission of dossier	Dispersive use	€7,000	X	X	X	X	X	X	(X)	X	X
	Non-dispersive use	€4,400	X	X	X	X	X	X	(X)	X	X
Revise SDS (if new classification)	Dispersive use	€500	X		X	X	X	X	(X)	X	X
	Non-dispersive use	€200	X		X	X	X	X	(X)	X	X
CSA costs only if possibility of a PBT vPvB, CMR classification (new or not)	Dispersive use	€4,200					(X)	(X)	(X)	(X)	(X)
	Non-dispersive use	€1,500					(X)	(X)	(X)	(X)	(X)
Up-date of dossier following animal testing	No-update required	€0	X		X	X	X	X	(X)	X	X
	Up-date (time only – fees additional)	€1,000	X		X	X	X	X	(X)	X	X
Proposal for animal testing	No animal tests required	€0	X		X	X	X	X	(X)	X	X
	Per new animal test	€500	X		X	X	X	X	(X)	X	X
PBT assessment	No P, B or T property	€0	X		X	X	X	X	(X)	X	X
	P, B or T property	€200	X		X	X	X	X	(X)	X	X
Summary of test and other data (e.g. producing robust study summaries)	Available data plus no-testing data for Annex VII (3a as well as baseline as appropriate)	€500	(X)		X						
	Available data plus testing and no-testing data for Annex VII (3b as well as baseline/ 3a as appropriate)	€750	(X)		(X)	X					
	Available data plus no-testing data for Annex VII and selected VIII endpoints (4a, 4c/4d as appropriate)	€750					X		(X)		
	Available data plus testing	€1,000					(X)	X	(X)		

Table 7.8: Different cost types incurred for the registration of a substance (where X denotes where a cost is incurred under an option and (X) denotes where the cost is dependent on the outcome of screening for properties of concern according to the decision rules applied under each option)											
	Variable Factors	**Assumed Cost**	**BL**	**Opt 2**	**Opt 3a**	**Opt 3b**	**Opt 4a**	**Opt 4b**	**Opts 4c/d**	**Opt 5a**	**Opt 5b**
	and no-testing data for Annex VII and selected VIII endpoints (4b, 4a/4c/4d as appropriate)										
	Available data plus no-testing data for Annex VIII (5a)	€1,000								X	
	Available data plus testing and no-testing data for Annex VIII (5b as well as 5b as appropriate)	€1,250								(X)	X

Table 7.9: Fees and Charges (€) Payable to ECHA by Size of Companies (Regulation No 340/2008) for Substances in the Range of 1 to 10 Tonnes				
	LE[1] (Individual - joint submission)	**ME[1] (Individual – joint submission)**	**SE[1] (Individual – joint submission)**	**MiE[1] (Individual s – joint submission)**
Registration of substances and intermediates	€ 1,600 – € 1,200	€ 1,120 – € 840	€ 640 – € 480	€ 160 – € 120
Update of the tonnage range:				
From 1-10 tonnes range to 10-100 tonnes range	€ 2,700 – € 2,025	€ 1,890 – € 1,418	€ 1,080 – € 810	€ 270 – € 203
From 1-10 tonnes range to 100-1,000 tonnes range	€ 9,900 – € 7,425	€ 6,930 – € 5,198	€ 3,960 – € 2,970	€ 990 – € 743
From 1-10 tonnes range to over 1,000 tonnes range	€ 29,400 – € 22,050	€ 20,580 – € 15,435	€ 11,760 – € 8,820	€ 2,940 – € 2,205
Other updates:				
Change in identity of the registrant	€ 1,500	€ 1,050	€ 600	€ 150
Change in the access granted to information in the submission (per item)	€ 1,500 – € 1,125	€ 1,050 – € 788	€ 600 – € 450	€ 150 – € 113
Request of confidentiality:				
Degree of purity and/or identity of impurities or additives	€ 4,500 – € 3,375	€ 3,150 – € 2,363	€ 1,800 – € 1,350	€ 450 – € 338
Relevant tonnage band	€ 1,500 – € 1,125	€ 1,050 – € 788	€ 600 – € 450	€ 150 – € 113
A study summary or a robust study summary	€ 4,500 – € 3,375	€ 3,150 – € 2,363	€ 1,800 – € 1,350	€ 450 – € 338
Information in the safety data sheet	€ 3,000 – € 2,250	€ 2,100 – € 1,575	€ 1,200 – € 900	€ 300 – € 225
Trade name of the substance	€ 1,500 – € 1,125	€ 1,050 – € 788	€ 600 – € 450	€ 150 – € 113
Note 1: LE: Large Enterprises; ME: Medium Enterprises; SE: Small Enterprises; MiE: Micro Enterprises				

For the development of a SDS, CSES (2012) according to information from one consultant provides a figure of €200. Additional costs could come from the need for translation of the SDSs into the different languages of the Member States and CSES (2012) indicates a cost of €100-€300 per language. However, the software used to produce the SDSs is usually able to provide automatic translations into any of the 27 languages of the EU. As a result, we have allowed for some additional language translation related costs, but have kept these to a few hundred Euro to reflect the fact that these low volume substances are only likely to be used by a small set of downstream users.

In addition, the cost of a single intermediate registration was estimated to be approximately €10,000 (CSES, 2012), including fees. This compares to an assumed cost of €8,820 in the Revised BIA (RPA, 2003) excluding fees. Adding the registration fee for an intermediate (that is equal to the fee for substances in the range 1 to 10 tonnes) the two figures match, having an estimate of €9,000 to €11,000 depending on the size of the company.

Moreover, CSES (2012) reports that many companies turn to consultants, with the associated fees being between 10-25% of the registration fee. Considering that the registration fee for substances in the range over 1,000 tonnes is between €3,100 for micro enterprises and €31,000 for large enterprises and assuming that consultancies would charge the same fees for substances in the range 1 to 10 tonnes, this implies total costs (including registration fees) of around €3,500 to €6,000. We believe these figures may be on the low side, and believe those given in Table 7.7 are more realistic.

8. RESULTS OF THE OPTIONS APPRAISAL – PREDICTED COSTS

8.1 Overview

As discussed in Section 6, the new model has been used to generate 10,000 virtual substances, each with a different eco/toxicological profile. For each virtual substance the model provides the expected outcome under the baseline and for each option, generating information on performance in relation to:

- the estimated costs to companies associated with the administration and fulfillment of registration requirements on a per substance basis, where these also reflect differences in the requirements assumed to apply under each of the options;
- the estimated fees to registrants, taking into account the availability of data and the variations in fees payable by companies of different sizes;
- the potential impacts of the above on the other operations of registrants in terms of innovation and competitiveness.

The remainder of this section provides a discussion on the above, with this including a comparison across the options. Predicted benefits are set out in Section 9, with Section 10 bringing these two elements together to provide an indication of the overall performance of the options.

8.2 Total Costs of the Baseline and Options

8.2.1 Total Costs

Table 8.1 provides data on the costs of read across, QSAR, testing and registration under each of the options, listed and ranked by the total costs. These are essentially 'statistical' costs as they are derived using a probabilistic modelling approach.

As can be seen from Table 8.1, the costs of read across, QSARs and testing, and the associated registration costs increase with the amount of information required, as expected. The relative significance of the different cost elements varies across the options, with testing costs becoming the major cost burden as one moves higher up the options, as can be seen from Figure 8.1.

Under the Baseline requirements, the registration of substances in quantities of between 1 and 10 tonnes by the 2018 deadline will cost to the industry around 170 million euros. The requirement of all Annex VII endpoints for the hazardous substances (option 3a) or for all the substances (option 3b), would cost respectively €40 million and 480 million more in comparison to the baseline.

Under Option 2, as testing is not required, costs are mainly due to the administrative part of the registration, as evident from Figure 8.2. Registration costs remain the major burden for the baseline and for Option 3a and 3b too. Due to the CMR and

PBT/vPvB screening, under Option 4c and 4d the costs associated with read across and (Q)SARs are the largest proportion on the total costs.

Table 8.1: Estimated Costs of Read Across, QSAR, Testing, Registration and Totals (in € million)

	Read Across, QSAR	Testing Cost	Registration Costs	Registration fees	Total Costs
Option 1	0.0	0.0	0.0	0.0	0.0
Option 4c	14.7	5.3	1.8	0.3	22.0
Option 4d	18.5	5.7	1.9	0.3	26.5
Option 2	0.0	0.0	90.4	28.8	119.2
Baseline	18.1	23.5	120.1	6.2	167.9
Option 3a	18.1	61.0	124.5	6.2	209.8
Option 3b	18.1	95.0	135.1	0.0	248.3
Option 4a	20.7	439.0	134.5	6.5	600.8
Option 4b	20.7	652.5	149.7	0.0	822.9
Option 5a	21.7	1,681.2	170.3	4.2	1,877.4
Option 5b	21.7	2,103.8	187.2	0.0	2,312.7

Note: These costs are "statistical" as they have been derived using a model based on the use of probabilistic Monte Carlo analysis to reflect uncertainties in underlying data.

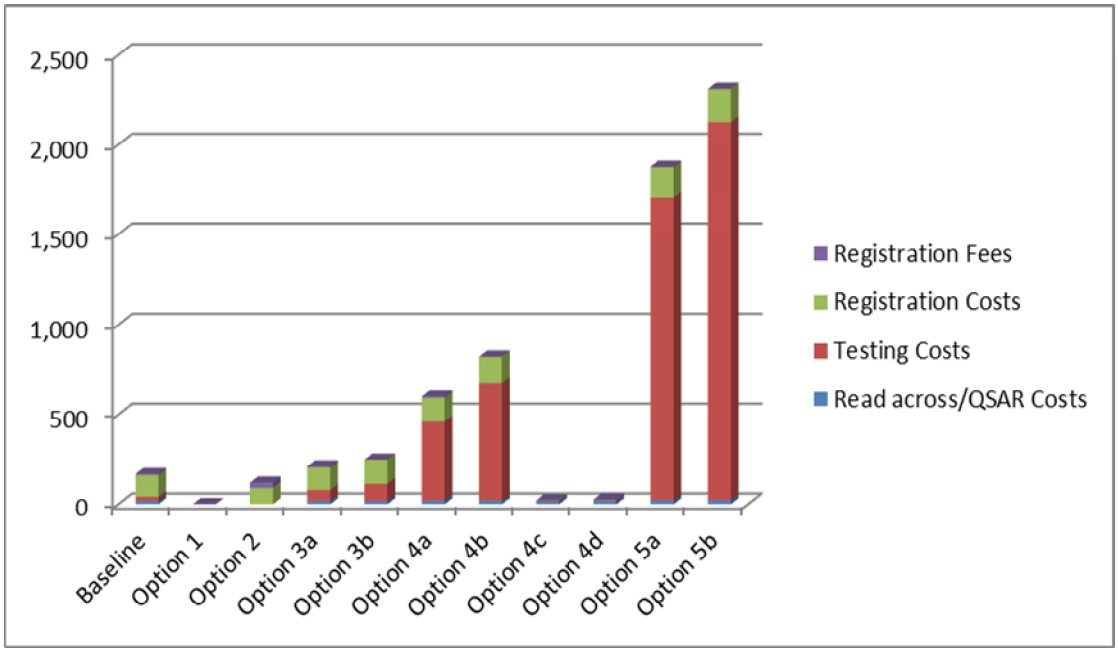


Figure 8.1: Total costs for each option by cost types (million euros)

Option 4a and 4b would cost respectively four and five times more in comparison to the baseline. This is due to the costs of some of the tests required, mainly mutagenicity tests (€28,000 as presented in Table 7.7) and repeat dose toxicity tests (€50,000). The M and R and PBT/vPvB screening under Options 4c and 4d cut the costs to registrants drastically, respectively of the order of ten and six times less when compared to the Baseline, as registration under these Options is required only for those substances found to be positive for these outcomes by the screening (carried out using QSARs and read across on selected relevant endpoints only).

Options 5a and 5b would cost to the industry respectively eleven and thirteen times more in comparison with the baseline, due to the requirement of all Annex VIII endpoints (costs are mainly driven by the reproductive toxicity test, around €110,000 each).

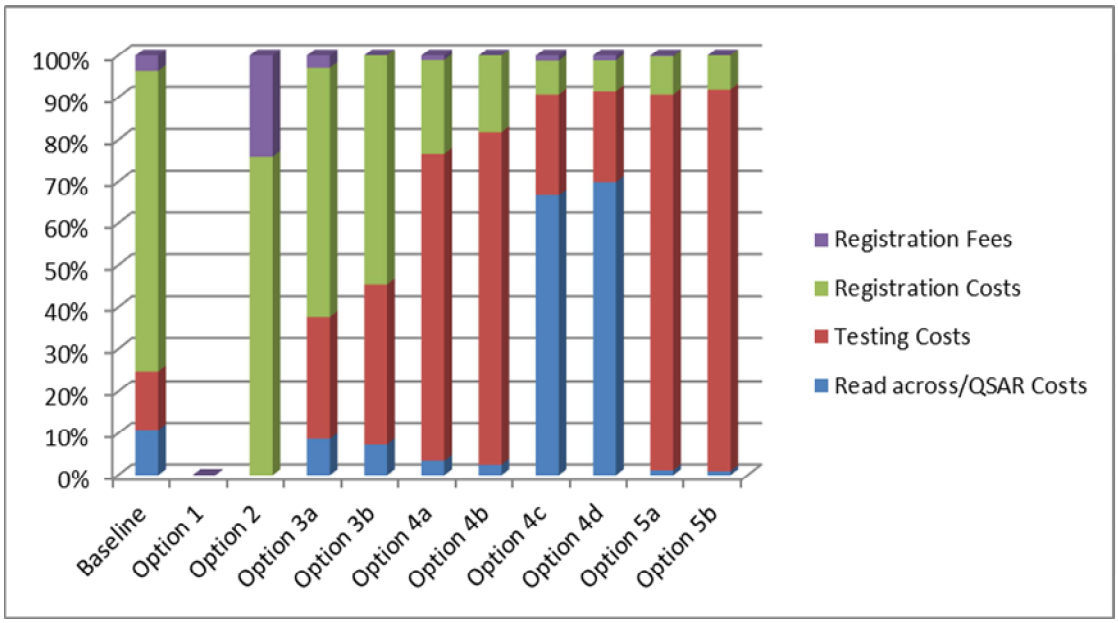


Figure 8.2: Proportion fo the different cost types on the total costs by options

What becomes clear from Table 8.1 is that refinements could be carried out on some of the options considered here to reduce their cost implications. For example, Options 4a, 4b, 5a and 5b do not include the "any other human health and environmental classification AND dispersive or diffuse use" hurdle that is included in the Baseline. If the dispersive /diffuse use hurdle was included in these options, then their testing and registration costs would reduce. Similarly, new Options 5c and 5d could be developed along the same lines as Options 4c and 4d, albeit with higher test costs but which might also perform better in terms of the identification of a higher number of new hazardous properties in relation to any human health or environmental classification, as well as mutagens and reprotoxins and PBT/vPvBs (see also Section 9).

It is also important to stress that the lower testing costs presented in Table 8.1 for the Baseline and Options 3a and 3b may in fact be misleading. As will be seen from the discussion presented in Section 9, these options are associated with high numbers of false positive outcomes in terms of their identification of possible mutagens, reprotoxins and PBT/vPvB substances. As a result, registrants may respond to such QSAR and read across indications by carrying out new testing, with this then resulting in the costs under these options moving closer to those under Options 4a and 4b.

Differences in fees are also of note. As result of Article 74(2) under Title IX of the REACH Regulation, exempting registrants of substances between 1 and 10 tonnes from paying registration fees where the registration dossier contains the full information in Annex VII also has a significant effect on the relative costs of the

different Options. Because strict registration in line with Option 2, that prescribes the provision of just the physicochemical data listed in Annex VII, would not comply with this Article it has the highest costs in terms of fees to be paid to ECHA. Moreover, since Options 3b, 4b and 5b prescribe the provision of all Annex VII endpoints, no fees would have to be paid under these options.

8.2.2 Average Statistical Costs and Company Size

The average costs per statistical substance and per manufacturer/importer under each option are presented in Table 8.2 below.

Table 8.2: Statistical average costs per substances and per manufacturers/importers (in €)

	Average total cost per substance	Average total cost per M/I*
Baseline	9,590	6,826
Option 1	0	-
Option 2	6,810	4,847
Option 3a	11,990	8,529
Option 3b	14,190	10,095
Option 4a	34,330	24,428
Option 4b	47,020	1,077
Option 4c	1,260	33,460
Option 4d	1,510	894
Option 5a	107,280	76,338
Option 5b	132,150	94,035

* Assumes 24,600 manufacturers or importers of substances involved in registration of 1 to 10 tonne substances, to allow for more than one registration per substance.

In the assessment of the business impacts of new regulations in the chemical sector (RPA, 2002), a survey of chemical manufacturers was carried out to gather information from companies regarding the number of chemicals produced each year and about the percentage of chemicals produced by tonnage. The results of this exercise are presented in Tables 8.3 and 8.4 below.

Table 8.3: Number of chemicals produced by respondent each year (in percentage)

	SME	Large
<50	48%	36%
50 – 100	20%	12%
100 – 1,000	28%	35%
>1,000	4%	17%

Source: RPA (2002)

Table 8.4: Percentage of chemicals produced by tonnage

	SME	Large
>1,000	23%	32%
>100	15%	18%
>10	20%	26%
>1	21%	19%
<1	18%	6%

Source: RPA (2002)

As can be seen from Table 8.3, around 50% of the small and medium sized enterprises (SMEs) manufacture less than 50 substances per year, and from Table 8.4, around 20% of these would be in the 1 to 10 tonnage band. In order to provide some examples on the costs that would be incurred by different companies under each option, the case studies in the Appendix to the CSES (2012) study have been used here to produce estimates for illustrative enterprises.

Microenterprises

The case study number 6 (CSES, 2012) is about a small producer of solid industrial tyres selling mainly in Europe. For illustrative purpose it is assumed that this company is a microenterprise[57]. The company manufactures 10 substances, 2 of them are assumed to fall in the 1 to 10 tonnage band (20% of the total as presented in Table 8.4). Table 8.5 shows the statistical average costs for this company. Assuming a mark-up of 15,000 euros per tonne and a production volume of 10 tonnes for both of the substances in this example (with the two substances remaining within this company's production portfolio for at least 20 years), the profit of the company associated with the manufacture of the two substances in the 1 to 10 tonnage band is around €300,000 euros per year, or €4.4 million over 20 years discounted at 4%. The fourth column in the table shows the proportion of the registration costs as a percentage of the profit associated with the two substances.

Table 8.5: Statistical average costs per substance for a microenterprise and illustrative example

	Statistical average costs per substance	Costs for the illustrative case	Cost proportion as a % of profits over 20 years
Baseline	9,300	18,600	0.4%
Option 1	0	0	0
Option 2	5,400	10,800	0.25%
Option 3a	11,800	23,600	0.50%
Option 3b	14,000	28,000	0.60%
Option 4a	34,100	68,200	1.50%
Option 4b	45,600	91,200	2.10%
Option 4c	900	1,800	0.04%
Option 4d	1,200	2,400	0.05%
Option 5a	106,000	212,000	4.80%
Option 5b	128,200	256,400	5.80%

Note: A discount rate of 4% has been applied for consistency with previous assessments. Present value figures rounded to two significant digits.

Small Enterprises

The case study number 7 in the CSES report describes a small importer of colouring substances for the textiles, tanning and paper industry. The total number of substances imported is around 500, of which it is assumed that 20% are imported in the 1 to 10 tonnage band (around 100 substances). The assumed mark-up on each substance is of around 5,000 euros per tonne, resulting in an associated profit of €5

[57] Less than 10 employees and with a turnover less than 2 million euros.

million per year and in €73 million over 20 years discounted at 4%, as illustrated in Table 8.6.

For this company, the higher options are likely to have a much more significant impact on the ability of the company to continue importing all of the substances within its current portfolio unless either the manufacturer in the source company or its downstream users were willing to help meet registration costs.

Table 8.6: Statistical average costs per substance for a small enterprise and illustrative example

	Statistical average costs per substance	Costs for the illustrative case	Cost proportion as a % of profit over 20 years
Baseline	19,300	1,930,000	2.64%
Option 1	0	0	0
Option 2	12,300	1,230,000	1.6.8%
Option 3a	23,600	2,360,000	3.23%
Option 3b	28,400	2,840,000	3.89%
Option 4a	68,800	6,880,000	9.42%
Option 4b	96,200	9,620,000	13.18%
Option 4c	2,200	220,000	0.3%
Option 4d	2,800	2,400	0.38%
Option 5a	220,700	22,070,000	30.23%
Option 5b	272,300	27,230,000	37.30%

Medium Enterprises

Case study number 3 in the Appendix to the CSES report describes a medium manufacturer of activated carbon, producing around 20 substances of which 4 are assumed here to be manufactured in the 1 to 10 tonnage band. The assumed mark-up is of around 15,000 euros per tonne, resulting in a turnover of 600,000 euros per year (assuming a production of 10 tonnes for each substance) and 8.7 million euros over 20 years discounted at 4%.

Table 8.7: Statistical average costs per substance for a medium enterprise and illustrative example

	Statistical average costs per substance	Costs for the illustrative case	Cost proportion as a % of profit over 20 years
Baseline	45,000	180,000	2.07%
Option 1	0	0	0%
Option 2	30,900	123,600	1.42%
Option 3a	54,500	218,000	2.51%
Option 3b	65,100	260,400	2.99%
Option 4a	158,800	635,200	7.30%
Option 4b	219,600	878,400	10.10%
Option 4c	5,700	22,800	0.26%
Option 4d	6,700	26,800	0.31%
Option 5a	506,300	2,025,200	23.28%
Option 5b	625,600	2,502,400	28.76%

Large Enterprises

Case study number 1 of the CSES report presents a large manufacturer and importer of basic and specialty chemicals, producing around 50 substances of which 10 are assumed to be manufactured/imported in the 1 to 10 tonnage band. Assuming that five substances are manufactured in Europe and sold with a mark-up of 15,000 euros per tonne and the other five are imported, with a mark-up of 5,000 euros per tonne (and all the ten substances are manufactured or imported in quantities of ten tonnes), the associated turnover is of around 1 million per year or 14.6 million over 20 years discounted at 4%.

Table 8.8: Statistical average costs per substance for a large enterprise and illustrative example

	Statistical average costs per substance	Costs for the illustrative case	Cost proportion as a % of profit over 20 years
Baseline	97,700	488,500	3.35%
Option 1	0	0	0
Option 2	72,600	363,000	2.49%
Option 3a	119,400	597,000	4.09%
Option 3b	140,800	704,000	4.82%
Option 4a	351,500	1,757,500	12.04%
Option 4b	478,000	2,390,000	16.37%
Option 4c	13,500	67,500	0.46%
Option 4d	16,300	81,500	0.56%
Option 5a	1,083,000	5,415,000	37.09%
Option 5b	1,333,300	6,666,500	45.66%

8.3 Substance Withdrawal

8.3.1 Data from the CSES Studies

It is accepted that the registration requirements of REACH, as well as being fundamental to ensuring the safe use of chemicals, may lead to some substances being withdrawn from the EU market either to the financial cost of registering the substance, more general rationalisation of the product portfolio, or withdrawal of a substance due to its hazardous properties. The recent CSES study asked manufacturers whether they had decided to withdraw substances from the market as a result of REACH. Data on responses to this question are given in Table 8.2 below.

As can be seen from Table 8.9, the first round of registration led to around 25% of responding companies to withdraw substances from the market, with a further 25% indicating that they expect to withdraw substances in the future, presumably in response to the registration requirements for substances placed on the market at lower volumes.

It is interesting to consider the size distribution of those companies that have either withdrawn substances or which are considering doing so in the future. The majority of such respondents are large companies, rather than micro enterprises or SMEs. Indeed, the majority of micro enterprises indicated that they do not expect to withdraw substances from the market in the future, while only roughly half of the

small and medium sized companies indicated that did not expect to do so, and a smaller proportion of large companies indicated that they did not expect to do so. One interpretation of these data is that larger companies had broader product portfolios pre-REACH and hence that there has been a greater level of production rationalisation within these companies.

Table 8.9: Responses to CSES Questionnaire on Extent of Substance Withdrawal

Business size	**One of the main concerns of users of chemicals is that REACH will lead to the withdrawal of chemical substances. In your business, have you decided to withdraw any chemical substance from the market as a result of REACH?**			
	YES	NO, and we do not expect to do so in the future	NO, but we are considering doing it in the future	No experience
Micro (1-9 employees)	1	7	3	1
Small (10-49 employees)	8	20	9	2
Medium (50-249 employees)	23	43	23	5
Large (more than 250 employees)	44	54	36	20
Business size unknown	0	1	1	0
Totals	76	125	72	28

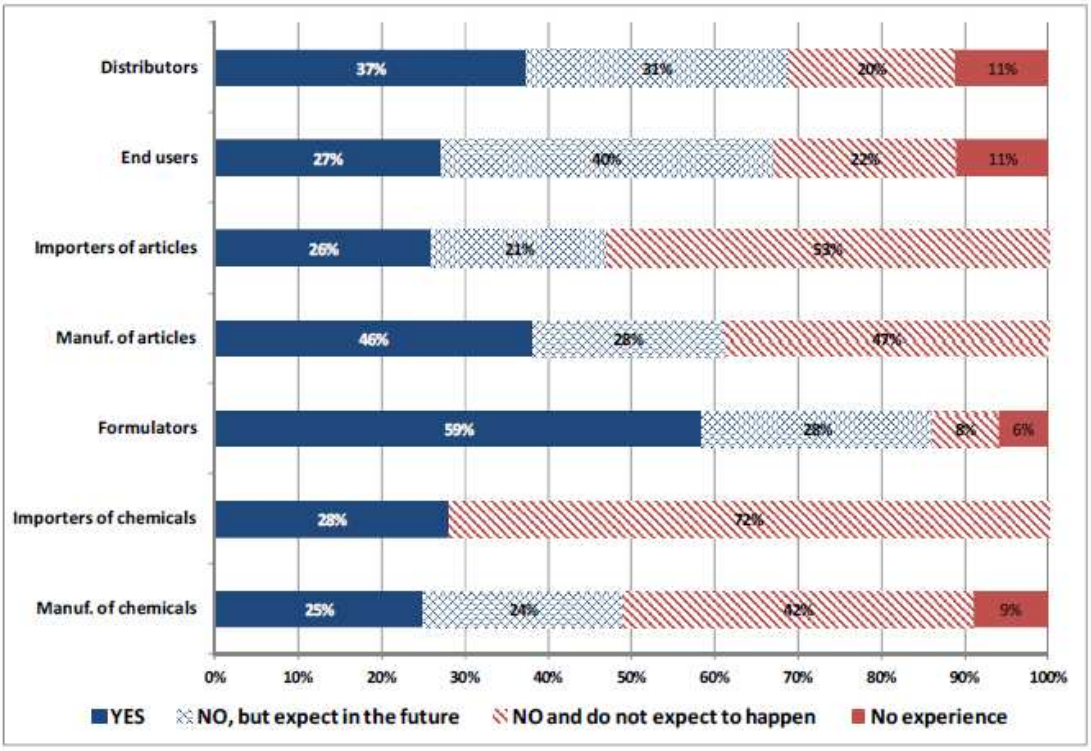
Source: CSES (2012)
Note: These data were provided by CSES to RPA for use in Commission studies. The interpretation of the data is RPA's responsibility.

This interpretation is supported to a degree by responses to a follow-up question as reported in Table further 8.10. As can be seen from this table, the majority of companies that have withdrawn a substance from the market did so due to the costs of registration. This holds across companies falling in all size bands, with a substance being placed on the candidate list being the second most likely reason. However, what is not clear from these data is whether other factors, such as the likelihood of the substance being entered onto the candidate list at some point in the future (e.g. because it is a CMR), also placed a role in these financial decisions.

Of those that have withdrawn a substance from the market already, 49% indicated that this applied to between 2 to 5 substances, while 30% indicated it applied to only 1 substance and 14% indicating that it applied to more than 6 substances (and for half of this latter group to more than 10 substances). Taken together, this suggests that over 15% of respondents to the CSES questionnaire have withdrawn 2 or more substances from the market. Unfortunately, it is not possible to determine the number of substances that this relates to, as two or more companies may have withdrawn the same substance; as a maximum, assuming each withdrawn substance is different, this could translate to around 230 substances (based on the average for the different response bands).

Table 8.10: Responses to CSES Questionnaire on Reasons for Substance Withdrawal			
Business size	**What were the reason(s) that led you to withdraw a substance from the market (please state more than one if applicable)**		
	The costs for registration were too high and did not justify maintaining the substance in the market	**The substance was placed in the candidate list for authorisation**	**The substance was placed in the list of restricted substances**
Micro (1-9 employees)	1	0	0
Small (10-49 employees)	6	2	0
Medium (50-249 employees)	18	4	2
Large (more than 250 employees)	33	13	4
Business size unknown	0	0	0
Source: CSES (2012)			

More generally, the CSES Survey indicates that 37% of firms have experienced a withdrawal of substances as a result of REACH (either as suppliers or as users of substances), with an additional ~30% of total respondents expecting this to happen in the future.



Source: CSES survey

Figure 8.3: Experience of withdrawal of chemical substances from the market as a result of REACH - (Manufacturers or importers of chemicals indicate their own activity in relation to chemicals they produce/import. Remaining categories referred to their experience in relation to the withdrawal of substances they use). Source: CSES

The implications of the above findings with respect to substances to be registered at between 1 and 10 tonnes are that levels of substance withdrawal will be sensitive to costs. Thus, the greater the costs of registration, the higher will be the likely levels of substance withdrawal. In this respect, it could by hypothesized that:

- The lowest levels of withdrawal will arise under Options 1, 4c and 4d and Option 2, and in this order respectively. These options may perform better than the baseline in this resepct, as the level of production rationalisation triggered by Registration requirements is likely to be lower. Option 4c and 4d are expected to perform better than Option 2 in this respect, as Registration costs are associated with only those substances most likely to be subject to further regulation under REACH through either Authorisation or Restriction.

- The highest levels of withdrawal are expected to occur under Options 4a and 4b, 5a and 5b, in increasing order. These would all place additional test and CSA requirements on registrants, thus increasing both the costs and the time taken to meet requirements.

- Given that the cost increases for Options 3a and 3b over the baseline are marginal, one would expect all three of these options to result in a similar level of substance withdrawal. This is likely to be somewhat higher than the rates reported to date, but in line with the responses reported above to the CSES survey.

Note this is in line with previous expectations. The Revised Business Impact Assessment (RPA, 2003) provided estimates of the total number of chemical substances that might be withdrawn from the EU market as a result of REACH, with these findings based on consultation with industry and the findings of the earlier BIA work. For substances placed on the market at less than 10 tonnes per year, it was estimated that around 2,850 might be withdrawn from the market. It was anticipated that the costs of meeting registration requirements would lead to withdrawals to a greater degree than, for example, the need to demonstrate safe use; however, for CMR substances, the provisions regarding authorisation and the potential for candidate listing and prioritisation as a Substance of Very High Concern were also considered likely to impact on the registration decisions of manufacturers and importers.

The Revised BIA was only one study which examined the potential for substance withdrawal. Several other studies were carried out by industry organisations which predicted much higher rates of withdrawal from the market, mainly for economic reasons, with this predicted as leading to impacts on the manufacturing sector as reflected by losses in gross added value and jobs[58]. The Commission carried out its own assessment in response to these concerns, which used a microeconomic model to predict the reaction of chemical manufacturers and downstream users to the additional

[58] ADL (2003): Economic effects of the EU substances policy, Supplement to the report on the BDI research project dated December 2002, August 2003 and Mercer Consultants (2003): Study of impact of European Chemicals Policy, March 2003.

costs to test and register the substances (Canton and Allen, 2003[59]). It concluded that while some substances might be withdrawn from the market, their number would be limited[60]. Through the model, the authors simulated the increase in chemical costs arising from testing and registration: these costs would be passed to downstream users in the form of higher prices of chemicals and as costs stemming from the need to substitute those chemicals withdrawn from the market. The results of the model indicated that even under a "higher substitution costs" scenario, just 1-2% of all substances would be withdrawn from the market (e.g. 600 if assuming a starting figure of 30,000 across all tonnage bands).

8.3.2 Implications of Substance Withdrawal on Innovation

According to the CSES Innovation report, it is still too early to assess the impacts of REACH in relation to innovation. However, it is noted in the report that product withdrawal could lead to larger manufacturing operations incurring costs related to finding or developing substitutes.

More generally though, the CSES innovation survey asked questions about the impacts of different aspects of REACH on innovation. One set of questions related to the impacts of a substance being placed on the candidate list. For a small percentage of respondents (under 11%) this triggered efforts to develop new substances. For a larger set (which will include formulators), it appears to have triggered initiatives aimed at developing alternative formulations (28%), while for others it led to requests for substitution by suppliers (23%).

In addition, the loss of substances from the market has been a key concern for many downstream user sectors, which fear that they will unable to remain competitive if substances are withdrawn from the EU market but remain available outside the EU. For example, the textile industry is especially concerned about the withdrawal of low production volume substances, believing that possible substitutes and reformulation changes could impede the quality of the overall product[61]. A different study, with a similar line of argumentation, has stated that the withdrawal of chemical substances may result in the reduced availability, and possibly the reduced performance, of chemical preparations available to downstream users (Commission of the European Communities, 2003, p. 16)[62].Analysis of individual responses to the CSES Survey

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59 Canton and Allen (2003): A microeconomic model to assess the economic impacts of the EU's New Chemicals Policy, prepared for DG Enterprise, November 2003.

60 Extended Impact Assessment of REACH (2003): *"REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning the Registration, Evaluation, Authorisation and Restrictions of Chemicals (REACH), establishing a European Chemicals Agency and amending Directive 1999/45/EC and Regulation (EC) {on Persistent Organic Pollutants" – Extended Impact Assessment*, Commission staff working paper, 2003, p. 15.

61 N.a.. (2005). *Analysis of the Potential Impacts of Reach on European Textile Supply Chains": Final Report*

62 Commission of the European Communities. (2003). *Commission staff working paper: of the European Parliament and the Council concerning the Registration, Evaluation, Authorisation and Restrictions of Chemicals (REACH), establishing a European Chemicals Agency and amending Directive 1999/45/EC and Regulation (EC) (on Persistent Organic Pollutants)Extended Impact Assessment.*

concerning downstream users suggests that 'the experience of withdrawal' does not generally mean a complete loss of access to the specific substance; rather the specific supplier has decided to discontinue trading the substance (CSES, 2012). According to the CSES Survey, a large proportion of downstream users that have experienced the withdrawal of at least one substance have switched to another supplier, with 63% switching to another supplier within the EU and around 40% to a non–EU supplier. So far, the most common response of firms to withdrawal was to identify substitutes (53% of respondents to the CSES survey indicated that this was their most common response). Only a small proportion of downstream users (~12%) indicated that they had decided to register the relevant substance themselves on one or more occasions.

Table 8.11: Responses of downstream users to the withdrawal of critical substances as a result of REACH (% among firms that have experience the withdrawal of at least one substance).

	Substituted with other substances with less hazardous properties		**Switched to another supplier based inside the EU**		**Switched to another supplier based outside the EU**		**The firm registered the relevant substance**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Never	9	6%	44	37%	76	67%	94	88%
Seldom	20	13%	18	15%	11	10%	3	3%
Sometimes	42	28%	35	29%	23	20%	7	7%
Frequently	37	25%	15	13%	4	4%	0	0%
Always	41	28%	8	7%	0	0%	3	3%
Total	**149**	**100%**	**120**	**100%**	**114**	**100%**	**107**	**100%**

Source: CSES (2012)

At this stage there is no evidence to suggest that substance withdrawal has had any impact on final consumers in terms of the variety of final products available or their prices, however, it is probably still too early to make any conclusive assessment (CSES, 2012).

8.3.3 Impacts on Innovation due to Diversion of Resources

The CSES innovation survey asked questions over the degree to which different REACH requirements impacted on companies decisions to invest in the development piloting and testing stages of new products or services. As can be seen from Table 8.12, the levels of turnover spent on research and development at the time of the survey was reported as being relative low by most respondents, i.e. less than 5% for most companies, with only 14% of respondents indicating that they spent over 5%. Perhaps of equal note is the percentage that either did not know or indicated that this was not relevant, at 24%.

Table 8.12: CSES Survey Responses on % of Turnover spent on Research and Development								
Business Size	(<1%)	(1-2%)	(2-5%)	(5-10%)	(>10%)	Don't know	Not relevant	**Grand Total**
(1-9)	6	2	5	5	2	4	15	44
(10-49)	15	16	22	14	10	13	14	118
(50-249)	17	19	38	16	9	30	7	184
(>250)	25	30	40	18	9	40	17	224
No answer		1	1					7
Grand Total	63	68	106	53	30	87	53	577
Source: CSES (2012)								

The survey also asked whether REACH has had an impact on investment decisions. The responses to this question are summarized in Table 8.13. As can be seen from the Table, most of those giving a direction of impact specifically in relation to the costs of registration indicated that this was negative (26%), however, the majority either said this was not relevant or gave no answer. However, if we consider responses by company size, then a significant number of micro and small enterprises indicated that registration fees have had an impact. One would expect the impact to be lower with respect to 1 to 10 tonne substances, as the fees are much lower for registration and are waived in those cases where full Annex VII data requirements are met. The impact of the different options considered here will vary depending on whether the current waiver of fees would continue, e.g. it would apply to meeting the full requirements under Option 5a or 5b, or for Option 2 under the reduced requirements.

Interestingly, a similar lower percentage of respondents to the survey (29%) indicated that testing costs had a negative impact on the levels of innovation. Again most of those responding to the survey did not answer this question, with around 26% indicating that testing costs were not relevant to their investments in to new product development. Such responses may not hold in relation to 1 to 10 tonne substances, if the costs of testing become significant as there is likely to be a much lower potential for sharing costs within a SIEF for these substances. This would be a particular concern with Options 4a, 4b and 5a and 5b.

Similar patterns also hold for responses as to the impacts of the cost of preparing a dossier on investment in new developments, and as these increase across the options one would expect the potential negative effects on innovation to also increase.

Interestingly, however, supply chain communication costs were not found by the CSES survey to have as significant an impact on investment decisions. In general, one would expect more supply chain communication to be required for substances registered to date than 1 to 10 tonne substances. This then implies that although the level of benefits that may be gained from reduced information requirement options – in particular Option 1 – may be less significant than for the other cost items.

Table 8.13: CSES Survey Responses on Impacts of REACH Requirements on Investment Decisions								
Business Size	**Don't know**	**Negative**	**Not relevant**	**Positive**	**Very negative**	**Very positive**	**No answer**	**Grand Total**
Registration costs								
(1-9)	1	8	13	1	5		16	44
(10-49)	5	12	38	1	15	1	46	118
(50-249)	8	36	47	4	11	1	77	184
(>250)	14	50	74	4	12	2	68	224
No answer		1			1		5	7
Grand Total	28	107	172	10	44	4	212	577
Testing costs								
(1-9)	2	7	12	1	6		16	44
(10-49)	4	18	30	1	16	1	48	118
(50-249)	7	31	45	3	23		75	184
(>250)	13	41	65	10	25	2	68	224
No answer		1			1		5	7
Grand Total	26	98	152	15	71	3	212	577
Costs of preparing the dossier								
(1-9)	2	9	11	1	5		16	44
(10-49)	4	15	31	1	20		47	118
(50-249)	7	38	42	2	16	1	78	184
(>250)	13	50	71	6	15	3	66	224
No answer		1			1		5	7
Grand Total	26	113	155	10	57	4	212	577
Supply chain communication costs								
(1-9)	4	8	10		5		17	44
(10-49)	7	22	18	7	9	5	50	118
(50-249)	16	34	42	9	6	1	76	184
(>250)	20	51	63	13	6	1	70	224
No answer					1		6	7
Grand Total	47	115	133	29	27	7	219	577
Source: CSES (2012)								

Taken together though, the responses to the CSES survey suggest that for a fairly stable set of companies (roughly 30% but varying by size and cost item), the registration fees, testing costs, dossier preparation costs and resource costs associated with supply chain communication can result in a significant diversion of resources away from innovative activities. Thus, as the costs of meeting requirements for 1 to 10 tonne substances rise at the company level, one could expect the impacts on innovation to also increase at least for a significant percentage of companies.

In the CSES Innovation Survey, 63% of respondents indicated that that the requirements of the REACH regulation had diverted resources from other 'truly'

innovative research (that is, the firm's planned, day-to-day R&D and innovation) activities. However, 46% of respondents to the CSES Innovation Survey indicated that there was an overall increase in expenditure on R&D and other innovative activities. Interviews with companies indicated that this was due to two factors: some R&D and innovation programmes could not be stopped due to their strategic importance to the firms in question, and some new opportunities had been opened up due to the coming into force of the Regulation. Indeed it has been noted in the CSES Innovation Report (2012) that innovation is driven by many factors outside REACH that have a greater impact than the Regulation itself, in particular the state of markets and technology.

In the CSES Innovation Survey, firms were asked whether the provisions as regards Confidential Business Information have been supportive of innovation. In total, 35% of survey respondents said that they did not, with 19% responding they do. A further 46% indicated that they do not know.

8.3.4 Impacts on SME companies

According to CSES (2012), as SMEs have limited resources, they have been disproportionately affected by the Regulation. While relatively few SMEs manufacturing chemicals have been affected by the first registration process, there is in general a sense that given the fixed aspects of certain implementation costs, the overall costs of REACH have a greater impact on SMEs and their capacity to maintain their presence in certain markets (CSES, 2012).

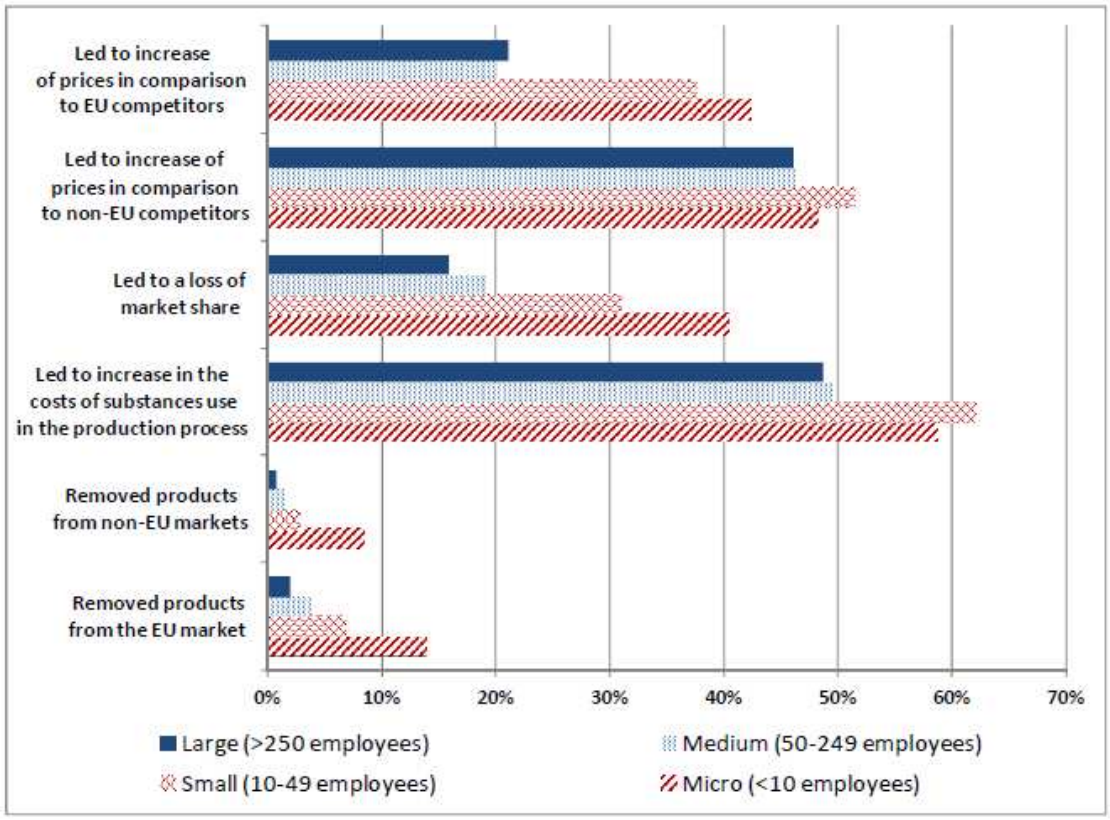
In particular, information transfers and communication on the basis of SDSs is an important burden on SMEs (CSES, 2012). Highly innovative exporting SMEs that concentrate on relatively few product lines are also unable to spread the costs to non-REACH affected products in their business portfolio making them vulnerable to competition from non-EU countries in export markets (CSES, 2012).

According to the CSES Survey, greater shares of SMEs believe that the Regulation has led to an increase in the prices of their products relative to their competitors, or a loss of markets in comparison to larger firms. The Survey also found that SMEs are not able to absorb the costs of REACH registration and often decide to abandon certain markets altogether or reduce their level of sales below the 1000 tonnes per year threshold. See Figure 8.4 below for further details.

The CSES Survey also asked participants how they would characterize their attitude towards the Regulation. While the response of SMEs did not significantly deviate from the overall picture, it is worth noting that micro-enterprises (<10 employees) had a more polarized view, with 46% having a negative view and 26% a positive one.

With regard to ECHA fees, there is relatively little difference in the perception of SMEs and larger enterprises. However, in relation to their overall turnover, the EHCA fees and registration costs more generally represent a much greater share of turnover for smaller firms (by a factor of four to five) (CSES, 2012).

In terms of input markets, SMEs tend to have fewer resources to recruit specialized staff and, even if activity is outsourced, there is still an opportunity cost (CSES Innovation Study, 2012). With regard to material inputs, the CSES Innovation Study found evidence of SME formulators having problems in financing letters of access, innovative importers closing their businesses as they could not afford registration costs, or having to review business relationships with long-standing suppliers pending appointment of an Only Representative.



Source: CSES survey

Figure 8.4: Impact of REACH on firms indicating that they agree or strongly agree with the following statements in relation to the impact of REACH to their business sorted by size (% of responding firms). Source: CSES (2012)

9. RESULTS OF THE OPTIONS APPRAISAL – PREDICTED HEALTH AND ENVIRONMENTAL BENEFITS

9.1 Introduction

The 2001 Commission White Paper that set out the Strategy for REACH identified a general lack of knowledge about the properties and uses of existing substances as a major problem, and identified the "*better protection of the environment and human health through appropriate risk management based on adequate information about the dangerous properties of chemicals*" as a key benefit of REACH.[63]

The model presented in Section 7 provides a range of outputs which help understand the potential health and environment benefits that could arise from the availability of better information on the properties of 1 to 10 tonne substances. This includes estimates of:

- the number of previously unclassified substances that would be newly classified as a result of new information stemming from the registration requirements identified;
- the number of already classified substances where additional classifications would be found;
- the number of possible and actual CMRs that would be newly identified; and
- the number of possible and actual PBT/vPvBs that would be newly identified.

In addition, as some of the options include the introduction of Chemical Safety Assessment requirements, there may be additional benefits from the formal development of exposure scenarios and the need to report on these and on recommended risk management measures.

Even in the absence of a Chemical Safety Assessment, the identification of new hazardous properties and hence reclassification of some 1 to 10 tonne substances may also result in benefits through up-dates of SDS and information on safe use; benefits may also arise from the fact that information on revised classifications will also feed into other legislation, triggering risk management requirements.

9.2 Benefits Associated with New Classifications

9.2.1 Identification of Hazardous Substances

One of the key premises underlying REACH is that the generation of new data on the properties of substances will lead to improved information and thus benefits by (RPA et al, 2012):

63 White Paper on the Strategy for a future Chemicals Policy COM(2001)88 final

- improving the classification of individual chemicals and thereby providing registrants and downstream users with better information on the hazards associated with their use;

- improving the quality of the data available to acting as the basis for preparing exposure scenarios, thereby improving the quality of recommendations on safe use and handling and appropriate risk management measures; and

- improving the data on substance classifications which feeds across into other legislation, with this creating indirect benefits.

It has always been argued that the generation of new data on the properties of chemicals would result in some proportion of existing (phase-in) classified substances and unclassified substances being found to have previously unidentified hazardous properties. As indicated above, the new identification of these properties would lead to benefits by enabling registrants to set out recommendations for appropriate risk management measures under REACH. Communication of information on both the newly identified properties and risk management measures through Safety Data Sheets (SDS, or extended SDS) and labels would lead to better control of risks, for example, through the implementation of exposure reducing measures triggered by other legislation (e.g. Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work). Such changes in classification, through the CLP Regulation, would also be picked up and drawn upon in the other legislation (see Section 9.4).

The results from applying the model described in Section 7 are presented below. However, before presenting those results, it is useful to consider experiences with REACH to date. The forthcoming study on the benefits of REACH (RPA et al, 2012) provides an analysis of some of the data coming out of the REACH Baseline Study (Oeko-Institut et al, 2011 in draft). Using data from REACH Baseline Study for 2007 and the updated study carried out in 2011, RPA et al (2012) carried out an analysis of the degree to which there have been changes in the classifications of substances registered up to 2011.

This assessment compares the classifications of 71 of the reference substances considered in the REACH Baseline Study; i.e. those registered at the time of the analysis out of the total number to be covered by the Baseline study. Interestingly, of these substances, 21% were not classified before REACH registration. After registration this number decreased to 11%, with this attributed to more data on hazardous properties becoming available during the registration process triggering classification for endpoints that were not previously classified (mainly due to a reliance on self-classification). In addition, there were increases in the percentages being classified against all endpoints examined (acute toxicity, repeated dose toxicity, irritation/corrosion, sensitisation, carcinogenicity, mutagenicity, reproductive toxicity and environment).

From the data presented below, it is clear that all options other than Options 1 and 2 should lead to new classifications for substances in the 1 to 10 tonnes band.

Newly Identifying Substances with Any Human Health or Environmental Classification

Table 9.1 provides data on the number of substances which are newly identified as having any human health or environmental classification - other than M, R or P/vP or B/vB which are considered separately - as predicted by the model. Here, two types of new "substance identification" must be differentiated from one another:

- the first type is previously unknown substances with any human health or environmental classification. These are substances which, at present, have no classification but which, if identified, would require one; and

- the second type of substance identification relates to substances which already have one or more classifications but which, if identified, would require additional classifications.

Table 9.1: Substances with Any Human Health or Environmental Hazard Classification

	Number of previously unknown substances with any new human health or environmental classification	Average number of classifications per new substance identified	Number of already classified substances where new classifications identified	For already classified substances - average number of classifications per substance
Baseline	8,309	2.0	120	1.0
Option 1	0	0.0	0	0.0
Option 2	0	0.0	0	0.0
Option 3a	8,310	2.1	125	1.0
Option 3b	9,532	2.0	125	1.0
Option 4a	8,262	2.1	183	1.0
Option 4b	9,599	2.0	183	1.0
Option 4c	82	2.3	0	0.0
Option 4d	92	2.3	0	0.0
Option 5a	10,341	2.6	1826	1.3
Option 5b	11,902	2.5	1826	1.3

As well as providing the numbers of each type identified under each option, the table also reports on the predicted "actual" number based on the classification and other assumptions set out in Sections 6 and 7. As noted earlier, the model generates virtual substances and effectively measures the extent to which each option is able to identify the substances of concern.

As can be seen from Table 9.1, because Options 1 and 2 have no requirements for generation of new information on hazardous properties, they do not identify any substances which were previously not known to have any health or environmental properties of concern (of which there are around 11,900 predicted under Option 5b). As will be recalled from Section 7, Option 1 does not require the registration of 1 to 10 tonne substances, while Option 2 requires registration based only on physicochemical properties plus other available data (both of which would act as the

basis for any existing classifications). All other options will therefore perform better in terms of identifying previously unknown hazardous properties and hence classifications.

Option 4c identifies the next lowest number of new hazardous properties, with this arising from the screening undertaken to check for CMR properties. In this case, 82 substances are newly identified as having hazardous properties. Option 4d, which also involves screening for PBT properties increases the number marginally to 88.

The Baseline (current registration requirements) and Option 3a newly identify similar numbers of substances as having properties of concern for human health and/or the environment at over 8,300, with this including new classifications for a further 120 or so substances which already held at least one classification. The average number of new classifications identified per newly classified substance is around 2, and the average number of new classifications is 1. Interestingly, Option 4a identifies a similar number of substances which were previously unknown to have a classification at over 8,250, but a higher number of new classifications for substances which already held one or more at over 180.

Unsurprisingly, Option 3b newly identifies more substances (at over 9,530) than either Options 3a or 4a due to the fact that its requirements for supplying data from tests (as opposed to using QSARs and read across) are not dependent on the mutagenic or reprotoxic (M or R), PBT or human health or environmental classification triggers incorporated into the other two options.

Because Option 4b includes additional endpoints from Annex VIII within the scope of its information requirements (with no trigger required), it identifies a higher number of substances both previously without (at around 9,600) and with classifications as having new classifications (over 180). However, because Options 5a and 5b increase information requirements to all Annex VIII they perform the best in terms of newly identifying hazardous properties, with Option 5b identifying almost 11,900 substances as having on average 2.5 previously unknown human health or environmental properties of concern; a further 1,800 substances are also identified as having additional properties of concern, with the average number of newly identified properties being 1.3.

Newly Identified Mutagenic and Reprotoxic Substances

In terms of substances with CMR properties, as noted in Section 7, the options do not include endpoints above those applicable to the 10-100 tonnage band (Annex VIII); in this respect it is important to note that a carcinogenicity (C) study is required only in Annex X although mutagenicity and repeated dose studies provide indications of carcinogenic characteristics. However, As a result, none of the options (nor the Baseline) are capable of proving substances are new carcinogen (i.e. ones that are not already known about) and the analysis only considers new Ms and Rs. It is recognised though that Ms and Rs may also be carcinogens.

Table 9.2 provides data on the total number of possible Ms and Rs that are predicted as being identified under each option, the number of possible Ms and Rs that are actually Ms and Rs, the number of false/positive identifications and the number from a statistical perspective of actual previously unknown MRs identified.

Table 9.2: Numbers of Newly Identified Ms and Rs

	Number of possible MRs identified	Number of possible MRs that are actually MRs	False positives	False negatives	Number of previously unknown MRs identified
Baseline	1327	184	1143	291	184
Option 1	0	0	0	475	0
Option 2	0	0	0	475	0
Option 3a	1421	196	1225	279	196
Option 3b	1488	204	1284	271	204
Option 4a	166	166	0	309	166
Option 4b	173	173	0	302	173
Option 4c	166	166	0	309	166
Option 4d	166	166	0	309	166
Option 5a	349	349	0	126	349
Option 5b	390	390	0	85	390

In terms of interpretation, it is worth identifying what could be taken as (but is not) a discrepancy between the options as regards the numbers identified. First inspection suggests that the Baseline, Options 3a and 3b identify more MRs than Options 4a or 4b. However, this is actually the result of combining recording of MRs and the presence of further (eukaryote) mutagenicity testing under Option 4 which substantially reduces the number of false positives compared to the Baseline and Options 3a and 3b (but does not included testing for R present in Option 5). The effect of this is that, where a substance is actually an R but also tests positive for M under the prokaryotic screening in Baseline or Option 3 (a or b) but negative under the Option 4 eukaryotic screening, this is recorded as an M under the Baseline and Option 3 but is eliminated (and not recorded) under Option 4.

However, from Table 9.2 it can be seen that Option 5 is the most successful (as it contains screening for M and R rather than just M) and the increased application of read across, QSARs and further testing under both Option 5a and 5b identifies over 70% (73% and 82%) of the 475 anticipated Ms and Rs across the full set of 1 to 10 tonne substances. In contrast, the reduced set of Annex VIII information to be provided under Option 4 results in only around 35% of the predicted unknown Ms and Rs being identified.

Perhaps of most concern is the fact that, under the Baseline and Options 3a and 3b, there would be a high number of false positive predictions due to the limited information required.

The possible misidentification of a substance as being a M or a R under the Baseline and Options 3a and 3b has potentially significant implications. From a human health perspective, it may lead to a substance wrongly identified as M or R being substituted

by one which is not, but which has other hazardous properties. This could lead to an increase in risks to workers or consumers, depending on exposures. It could also lead to companies unnecessarily having to take measures under other legislation (e.g. Carcinogens and Mutagens Directive) to reduce exposures in the workplace, with this misallocation of resources would reduce the availability of funds for other worker safety measures or for research and development activities.

Of course, it might also lead to registrants undertaking further testing in order to check for false-positive identifications on the basis of the minimal level of data required under Annex VII; in this respect, the costs that these lower information requirement options are aimed at avoiding would be incurred by a significant number of registrants in any event. Thus, in practice, the costs may move closer to those of Options 4 or 5.

False-positive outcomes could also lead to the withdrawal of misidentified M and R substances from the market, as a result of potential registrants deciding that undertaking further testing is not financially worthwhile or that the market for the substances is not valuable enough to continue supporting a substance that may in the future be subject to candidate listing and authorisation. This could have knock-on effects, for example, in terms of the loss of critical inputs and reformulation for downstream users.

Newly Identified Persistent, Bioaccumulative and Toxic (PBT)/Very Persistent and Very Bioaccumulative (vPvB) Substances

As noted earlier, REACH includes requirements for registration of substances at above 10 tonnes per year to provide data which would enable an assessment of persistence, bioaccumulation and toxicity (PBT) potentials, with this to be reported on in the CSA. For substances under 10 tonnes per year, such data should currently be provided in the registration dossier where it is available.

Table 9.3 provides data on the total number of PBTs/vPvBs that would be identified under each of the options and the number of previously unknown PBTs/vPvBs identified. As with the data on MRs, this includes data on both the number of possible PBTs/vPvBs identified by each option as distinct from the number that are predicted as "actually" being PBTs/vPvBs and the number of associated false positives.

As calculated in Section 7, a review of the most recent references indicates that an estimated 73 substances falling within the 1 to 10 tonnage band would be expected to exhibit PBT/vPvB properties (taking into account the probabilities of such substances existing and that they may meet criteria for both PBT and vPvB properties. Based on the probabilities set out in Section 7 and this maximum figure of 73, estimates have been derived of the number of possible PBT/vPvBs identified by each option, the number of actual PBTs and the numbers of false positives and false negatives. These are given in Table 9.3.

Table 9.3: Numbers of Newly Identified PBTs/vPvBs					
	Number of possible PBT/vPvB identified	**Number of possible PBT/vPvB that are actually PBT/vPvB**	**False positives**	**False negatives**	**Number of previously unknown PBT/vPvB Identified**
Baseline	407	19	387	55	19
Option 1	0	0	0	74	0
Option 2	0	0	0	74	0
Option 3a	480	21	459	53	21
Option 3b	503	22	481	52	22
Option 4a	83	11	72	63	11
Option 4b	84	11	73	63	11
Option 4c	3	0	3	74	0
Option 4d	83	11	72	63	11
Option 5a	120	17	103	57	17
Option 5b	121	17	104	57	17

As can be seen from Table 9.3, identification of such a small number of substances is, in most cases, associated with a large number of false positives (in part owing to the fact that only screening tests are included). Here, as with Ms and Rs, there are differences between options that on first inspection would appear to be (but are not) anomalies; they are, in fact, due to the differences between options concerning required data endpoints.

As would be expected, Options 1 and 2 fail to identify any new PBT or vPvB substances, with 14 such substances remaining unidentified.

The Baseline together with Option 3 (a or b) identify many of the PBT/vPvB substances but, in the process, also include a significant number of false positives. This is because both the Baseline and Option 3 (based on Annex VII endpoints) have no screening tests for persistence (P) and, as such, anything that is B and T or vB is identified (correctly or incorrectly) as a possible PBT/vPvB. These options both assume that registrants make use of available information only, where under these options this includes QSARs and read across. Expert judgement may then be applied to these data to reduce the number of substances that are falsely assumed to be PBTs or vPvBs, or further information (e.g. Annex VIII data) may be collected for verification purposes to minimise this problem (leading to outcomes, including costs, closer to those under Option 4).

Under Options 4a, b and d, one of the two Annex VIII screening tests for P is required (abiotic - hydrolysis) and this successfully reduces the number of false positives by eliminating those substances that do not test positive for the P endpoint using this test. However, for some substances, there may be a negative result in the abiotic - hydrolysis screening test for P/vP but a positive one for the other screening test for P (adsorption/ desorption) which is then correctly identified under Option 5 requirements.

The analysis carried out here suggests that all options other than Options 1, 2 and 4c would lead to the identification of previously unknown PBT and vPvB substances compared to the baseline. Thus, there would be some additional benefits in each case through further classification of such substances as a minimum.

However, as discussed for Ms and Rs, it is important to note that the potential false-positive identification of PBT and vPvB substances under all of the other options is an issue; it may lead to registrants withdrawing these substances from the market rather than undertaking further testing; this is due to the risk that confirmation of a substance as a PBT or vPvB also identifies it as a potential candidate for future Authorisation.

Further Discussion on Substance Withdrawal and Health and Environmental Benefits

As discussed in Section 8 and above, as the costs of registering a substance at between 1 to 10 tonnes increases so does the potential for registrants to withdraw the lowest valued of these substances from the market should downstream users not be willing to support their registration. The issue of substance withdrawal is important though not only in understanding impacts on the costs faced by businesses and the effects of these on innovation and competitiveness, but also in relation to potential health and environmental benefits.

In 2011, in response to a query by the Directors Contact Group, ECHA published a note reporting on the gap between pre-registration intentions and actual registrations within the first deadline. This note indicates that there is a gap of about 1,500 substances, or roughly 30% of all the intentions. Of these circa 1,500 substances, 34 substances were indicated as being "dropped" (no market / other reason); while a further 551 substances were not registered for "reason unknown".

The list of substances that were "dropped" was reviewed as part of the REACH benefits study (RPA *et al*, 2012), which found that several were on Annex VI of the CLP Regulation EC (No) 1272/2008. In particular, thirteen of the substances that were "dropped" were CMRs (Category 1a or 1b) listed on Annex VI of CLP (previously Annex 1 of Directive 67/548/EC) or have otherwise been identified as having CMR properties; and another four were listed in Annex VI of CLP for their health and environmental hazard properties. For such substances, REACH may have acted as a trigger for their final withdrawal from the market if pre-registration can be interpreted as indicating that there was an original intention to continue placing these substances on the market.

Out of the substances that were not registered and for which no reason was provided by the pre-registrant, some were identified as having a CMR Cat 1a or 1b classification under the CLP (Cat 1 or 2 under DSD) while others were identified as having highly aquatic toxic properties (RPA et al, 2012); the first set of these substances should have been registered by December 2010 to comply with REACH requirements, while those that are highly aquatic toxic should have been registered by December 2010 if they are placed on the market at greater than 100 tonnes per year.

For this latter set, it is less clear whether they have been withdrawn from the market or are manufactured or imported at less than 100 tonnes per year.

It is difficult from this information to draw any broader conclusions regarding the degree to which the different options considered here for 1 to 10 tonne substances would be likely to trigger the withdrawal of such substances compared to the baseline. It is also difficult to determine what the benefits of such substance withdrawal would be in the absence of clearer information on the risks that would be associated with their use and the degree to which they would be substituted by less hazardous alternatives.

9.3 Chemical Safety Assessment Requirements

9.3.1 Introduction

As noted in Section 1, one of the main aims of REACH is to provide a high level of protection of human health and the environment. One of the key elements within the Regulation for delivering these benefits is through requirements for the preparation of Chemical Safety Assessments (CSA) as part of the Chemical Safety Report. These requirements currently apply to all substances subject to registration in quantities of 10 tonnes or more per year per registrant, but not to substances registered at less than 10 tonnes per annum.

The preparation of a CSA and communication of the findings of this should lead to:

- uses where adequate control of risks cannot be demonstrated not being supported by the registrant, with this also being communicated in the SDS (although in such cases, under Article 37 downstream users are able to prepare a CSA in accordance with Annex XII of REACH to support their own continued use, unless exempted from so doing);
- risk management measures being (newly) identified and communicated so as to ensure safe use;
- manufacturers learn more about uses and better targeting their information provision towards controlling and reducing risks, as a result of the need to collect information from downstream users in order to prepare the CSA;
- a formal assessment of PBT properties, as this is an explicit requirement within the CSA; and
- advice on waste management becoming more specific in order to ensure safe disposal.

Only Options 4 and 5 include either the triggering of or a need to fulfill Article 14 requirements for the preparation of a CSA, followed by the need to prepare an extended SDS containing details of exposure scenarios and recommended risk management measures (as opposed to a simpler SDS). The triggering of Article 14 for registrants would also be likely to have implications for downstream users. It is assumed here that it would also trigger the downstream user requirements set out

under Article 37 (and in particular 37(4) and its exemptions), Article 38 with regard to reporting obligations and Article 39 on when these apply).

As indicated above, the aim of the exposure assessment carried out as part of a CSA is to enable registrants to identify appropriate risk management measures (RMMs), with these then circulated through the extended SDS. The circulation of such data throughout chemical supply chain is intended to better ensure the safe use of chemicals, thereby delivering human health and environmental benefits by either providing more detailed information or by requiring a higher level of risk management than has previously taken place.

Thus, where Options 4 or 5 identify substances having M, R, PBT or vPvB properties, then the CSA sub-option could be triggered. Based on the figures presented in Section 9.2 above, this would relate to:

- 166 M/R for Options 4a, 4c and 4d, and 173 for Option 4b, with a further 7 PBT/vPvB substances for Options 4a, 4b and 4d; and
- 349 M/R and 17 PBT/vPvB substances for Option 5a; and
- 390 M/R and 17 PBT/vPvB substances for Option 5b.

In these cases, a chemical safety assessment and the communication of information to downstream users through extended SDS may be of considerable value in ensuring that workers are adequately protected. This might also help ensure that other legislation, such as requirements under the Chemical Agents Directive or under the Carcinogens and Mutagens Directive (2004/37/EC) can be implemented effectively. Where PBT or vPvB properties trigger the need for a CSA this would include an assessment of these properties, which may help reduce emissions of such substances into the environment (depending on the nature of the uses and current emissions).

In this respect, it is important to note that the REACH benefits study (RPA et al, 2012) found that changes in classification and the communication of these downstream together with new risk management measures within extended SDS, appears to be resulting in downstream users responding to such information and adopting changes in risk management measures (although the study also highlighted the significant difficulties surrounding supply chain communication that currently exist).

Finally, it is important to consider the potential impacts of triggering the Article 37 requirements for downstream users. Although the impacts of these obligations were not costed in the analysis presented in Section 8, as noted there, this additional requirement could lead to significant costs for some downstream users. Unfortunately, it is not possible to predict what the extent of these costs might be. Similarly, it may increase the human health and environmental benefits under these options, as it helps ensure that downstream users adopt the most appropriate risk management measures for their activities.

9.4 Linkages to Other Legislation

9.4.1 Overview

Even in the absence of any requirements for a formal CSA, registrants of substances manufactured or imported at only 1 to 10 tonnes will have to take any new information on the hazardous properties of chemicals into account and up-date the safety data sheets sent out to customers when supplying the substances with any revised classifications and instructions on safe use; they will also need to notify ECHA of the changes in classification for entry of this information on its Classification and Labelling Inventory. Thus, there should be an improvement in the quality of the information sent to downstream users of chemicals.

In addition to the benefits gained through the communication of better information via up-dated SDS, new information on substances manufactured or imported only at 1 to 10 tonnes may trigger risk management measures under EU legislation that can be invoked on the basis of information that will be available as a result of the REACH information requirements.

While it is not the explicit purpose of REACH to deliver information on substances in order to facilitate the implementation of other pieces of EU legislation, the value of information generated under REACH to regulators is recognised under Recital 14, which states that:

> *"Available information, including that generated by this Regulation, should be used by the relevant actors in the application and implementation of appropriate Community legislation, for example that covering products, and Community voluntary instruments, such as the eco-labelling scheme."*

In addition, Recital 21 states that the information yielded on substances under REACH *"may also be used to initiate the authorisation or restrictions procedures under this Regulation or risk management procedures under other Community legislation."*

As such, the increased availability of information on substances and their uses resulting from REACH generates benefits in informing the implementation of other EU legislation. Since this is not an explicit objective of REACH, these may be considered ancillary or indirect benefits. The remainder of this sub-section describes the potential scope of such ancillary benefits, by identifying to what extent the data requirements of other EU legislation may be met by those under the baseline and the other proposed options for 1-10 tonne substances. (See Annex 2 for a more detailed discussion of the linkages between REACH and other legislation).

At the outset, it is important to highlight the assumption that human (worker, consumer and via the environment) and environmental exposure to 1 to 10 tonne substances will be lower than for high production volume substances by virtue of the lower volumes involved alone. This affects the relevance of the particular pieces of legislation to 1 to 10 tonne substances, and in turn the need for specific data on 1 to

10 tonne substances under these acts. However it must also be recognised that individual workers might have high exposures to a 1 to 10 tonne substance if adequate controls are not put in place.

Legislation where better information on 1 to 10 tonne substances would be of particular value includes the CLP Regulation; various pieces of worker health and safety legislation; some environmental legislation; and product legislation.

9.4.2 The Classification, Labelling and Packaging Regulation

Worker health and safety in particular, but also some environmental and product legislation, relies on hazard classification to trigger a risk assessment. For example, the Carcinogens and Mutagens Directive 2004/37/EC (CMD) relies on the identification of carcinogenic and mutagenic properties to trigger its provisions, without demanding a separate hazard assessment. The CMD currently refers to DSD/DPD classifications for these properties but work is underway to amend the CMD to refer to Carc. or Muta. (1A and 1B) under the CLP Regulation (Regulation (EC) No 1272/2008).

CLP classifications are based on available data. With the exception of data on physicochemical properties, there is no requirement under CLP for the generation of additional information solely for the purposes of classification. However, companies may choose to generate new data while fully respecting Articles 7 and 8 of CLP.

Article 5 (1) of the CLP Regulation provides a list of other data sources and for some substances this may include pre-existing data, and/or data generated under independent studies, or under other EU legislation (e.g. Biocides, Plant Protection Products, Cosmetics, Food Contact Materials legislation). However, for some chemical substances manufactured or imported into the EU, REACH may represent the main tool for generating data.

Thus, as discussed above, new data generated by REACH should make CLP classifications more reliable. In this respect Options 1 and 2 would result in the generation of no additional information to that already available or required under CLP (i.e. physicochemical data if this does not already exist, as this must be provided for conformance with the CLP Regulation). All of the other options would deliver some improved information on hazardous properties, although (Q)SAR data may need expert interpretation for classification purposes. The identification of certain properties, such as CMR properties, may also result in the need for harmonised classifications.

Thus, the effectiveness of the options in developing new information on hazardous properties and hence new classifications varies in comparison to the effectiveness in identifying hazardous properties. This suggests the ranking as set out in Table 9.4, in terms of the degree to which new and more reliable classification information is generated.

Table 9.4: Ranking of Options' Effectiveness in Developing New Hazard Data and Classifications			
	Rank in terms of identification of previously unknown human health or environmental classification	**Rank in terms of identification of previously unknown substances with a M or R classification**	**Rank in terms of identification of previously unknown substances with a PBT or vPvB classification**
Baseline	5	5	3
Option 1	10	10	9
Option 2	10	10	9
Option 3a	5	4	2
Option 3b	3	3	1
Option 4a	7	7	6
Option 4b	4	6	6
Option 4c	9	7	9
Option 4d	8	7	6
Option 5a	2	2	4
Option 5b	1	1	4

Those options that develop the most reliable information are those which include the generation of new test data, as this will provide the basis for setting DNELs/DMELs or PNECs. This is why Options 5a and b perform so well in terms of identification of new classifications. Although Options 3a and b also appears to be high ranking in terms of the numbers newly identified, as discussed above, this is accompanied by a high degree of both false-positive and false-negative outcomes; the same is true for the Baseline; in essence, Option 4b may actually provide more reliable data than these other options.

As any new classification information would be included in a revised SDS, together with any changes to labeling and recommendations for safe use, it would enable downstream users to adapt their handling and use accordingly.

9.4.3 Legislation on the Health and Safety of Workers

Legislation on the health and safety of workers that may benefit from new information on hazardous properties through changes in classification includes:

- Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work (CAD);
- the Carcinogens and Mutagens Directive 2004/37/EC (CMD);
- the Young Workers Directive 94/33/EC; and
- the Pregnant and Breastfeeding Workers Directive 92/85/EEC.

Given the lower production volumes for 1 to 10 tonnes substances, it can be assumed that fewer workers overall will be exposed to these substances than high production volume substances. However, significant exposure of workers involved in specific applications cannot be ruled out, in which case the availability of information on 1 to 10 tonne substances becomes highly relevant.

The CAD, CMD, Young Workers Directive and Pregnant Workers Directive all require the employer to undertake a risk assessment. The first step of the risk assessment involves the identification of hazards for which employers will draw on SDS provided by suppliers, as these need to be communicated for all substances independently of their production volumes in order to fulfil the requirements of REACH. Employers then combine this hazard data with exposure data generated for specific workstations to assess the risk to individual workers. The SDS should enable the employer to assess the risk to the health and safety of workers.

As such, having improved information on the hazardous properties of 1 to 10 substances should also improve the ability of employers to assess the risks to their workers of the use of different chemicals and to take action to reduce these. However, it must be remembered that an SDS will include exposure characterisation and handling instructions but will not include more detailed exposure scenarios and risk assessments.

Given that the options will vary with respect to the level and quality of information generated on hazardous properties, the potential benefits in terms of improving employers ability to protect workers will vary across the options.

- Those options that require the generation of information on mutagenicity, reprotoxicity and repeated dose toxicity are likely to lead to the greatest benefits as such classifications trigger specific requirements under the above listed legislation. However, as noted above, where these data are of poor reliability, generating false-positive classifications, then significant costs could be incurred by employers which would result in no actual health benefits. Similarly, high levels of false-negative outcomes suggest that potentially significant hazards (and risks depending on exposure patterns) are not being caught.

- Similarly, where an option requires the generation of information across all Annex VII endpoints – e.g. Option 3b and 4b – then employers would have better information on potential sensitisers, thereby enabling them to reduce exposures to such substances. The value of such information would be increased under Option 5b.

- For those options where information requirements are restricted to physicochemical data only (Option 2) or are only triggered by meeting Annex III criteria – i.e. the Baseline, Options 3a, 4a and c – then the value of information provided to employers may be reduced for non-Annex III phase-in 1 to 10 tonne substances.

In addition, as discussed above, where there is a requirement for the preparation of a CSA as part of Options 4 and 5, then the exposure assessments produced by registrants in order to fulfil this requirement could be used directly by the employer in order to fulfil his workplace risk assessment obligations under the various worker health and safety legislation.

9.4.4 Legislation on the Environment

Under current Annex VII requirements, information is required on aquatic toxicity and degradation, but not on other environmental endpoints, when Annex III criteria are met or when it is already available.

- Options 1 and 2 would provide a lower level of environmental data, restricted to only that which is already available under Option 2;
- Option 3a would provide a similar level of environmental data to the Baseline;
- Option 3b would provide a higher level of data, and together with Option 5b help identify the highest number of PBT or vPvB substances;
- Option 4, with the exception of 4d, would perform less than Options 3b and 5b and 5a; and
- although Option 5a would not perform as well in identifying as many PBT and vPvB substances, it is better than Option 3b in identifying other human health and environmental classifications.

The implementation of some environmental legislation benefits from the increased availability of data on substances resulting from REACH registration, as well as from the CLP notification requirements. The increased availability of hazard data (as well as data from a CSA where available on environmental risks associated with a particular use) is valuable in determining whether risk management measure should be applied. Hazard data allow for the identification of specific pollutants that may pose a risk to the environment, while data drawn from exposure scenarios – where these are available – can be useful in pointing to potential exposure pathways.

Key sectors of environmental legislation that could benefit from increased information requirements for 1 to 10 tonne substances include waste and water legislation.

- Waste legislation of relevance includes Directive 2008/98/EC (the Waste Framework Directive) establishes a legal framework for the treatment of waste within the Community and the Landfill Directive 1999/31/EC; and

- Water legislation of relevance includes the Water Framework Directive 2000/60/EC (WFD), and its daughter Directives on hazardous substances and groundwater.

Waste Legislation

With respect to waste legislation, it is assumed that the volumes of 1 to 10 tonne substances channelled into waste streams will be lower than those for the high production volume substances. Thus, there is less call for hazard data on 1 to 10 tonne substances under the Waste Framework Directive and other waste legislation. However, the potential value of such data cannot be ruled out where specific local waste streams may include significant quantities of one or more 1 to 10 tonne substances.

The Waste Framework Directive defines hazardous waste as waste that fulfils certain properties (e.g. explosive, oxidizing, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic, waste which releases toxic or very toxic gases in contact with water, air or an acid, sensitising, or ecotoxic) under the Dangerous Substances Directive 67/548/EEC (DSD) and the Dangerous Preparations Directive 199/45/EC (DPD) (the DSD and DPD are in the process of being repealed and replaced by CLP). Data generated under REACH can be used to inform whether or not a waste is considered hazardous and whether specific risk management measures should apply. Similarly, under the Landfill Directive information generated under REACH is useful to identify whether a waste contains substances that may render it hazardous and hence whether or not to apply the risk management measures for the landfill of hazardous waste.

Water Legislation

The main provision of the Water Framework Directive 2000/60/EC (WFD) with regard to hazardous substances is Article 16. Together with the daughter Directive 2008/105/EC on Environmental Quality Standards in the Field of Water Policy (EQS Directive), Article 16 of the WFD provides for the establishment of a list of priority substances, which present a significant risk to or via the aquatic environment, identified on the basis of risk assessment. Within the list of priority substances, priority hazardous substances, i.e. substances that are toxic, persistent and liable to bio-accumulate, or which give rise to an equivalent level of concern, are to be identified. The classification of substances as priority substances and priority hazardous substances triggers specific risk management measures. In the identification of priority substances, the WFD demands data specifically on the aquatic toxicity of substances. The WFD recognises that the selection of priority substances should take into account information from REACH risk assessments (during registration or substance evaluation) or use REACH methodology.

Under the current baseline requirements, the data to be provided for 1 to 10 tonne substances include that on short-term aquatic invertebrate toxicity, short term aquatic algal toxicity and biotic degradation (ready biodegradation). Data will be absent on short-term fish toxicity, long-term aquatic toxicity in vertebrate and invertebrate species and the bioaccumulation and bio-concentration potentials of substances.

It should be noted though that the WFD focuses on pollutants that are released into the environment in high volumes and, as such, 1 to 10 tonne substances do not make up the key focus of the WFD; although it is possible that a 1 to 10 tonne substance could be found through monitoring data to be a key pollutant of European Waters due to their PBT and vPvB properties and specific release patterns.

Under Directive 2006/11/EC on the Protection of Groundwater against Pollution and Deterioration, Member States must identify pollutants and groups of pollutants that have been identified as contributing to the characterisation of bodies, or groups of bodies, of groundwater as being at risk. For these pollutants, or groups of pollutants, Member States should set up threshold values i.e. a groundwater quality standard. In deriving these values they should consider the behaviour, toxicity, persistency and

bioaccumulation potential of the substances, drawing on REACH registration data. For 1 to 10 tonne substances, depending on the option, data availability may constrain the degree to which Member States will able to address any cases of significant exposures for selected water bodies.

9.4.5 Legislation Regulating Products

The chief benefit of REACH registration data to legislation regulating products is derived from the use of that data by producers to identify any risks that their products may pose to consumers. Under the baseline for 1 to 10 tonne substances, producers would draw on data in SDS on the hazardous properties of an individual substance and associated toxicity endpoints and marry this with information on product use to assess risks. For 1 to 10 tonne phase-in substances that do not meet the criteria of Annex III, no toxicity data is required to be generated under REACH, although available data on classifications would need to be reported in SDS.

In order to assess the potential benefits of further information requirements for 1 to 10 substances in relation to product legislation, one requires information on the extent to which 1 to 10 tonne substances are extensively used in a regulated product group. Although it is known that consumer products do contain low concentrations of low volume substances (e.g. cosmetics, etc.), the substances contained in many of these products are already controlled under other legislation. Within the scope of this study, it is not possible to identify those types of products where the availability of new information to producers would be of greatest value.

9.5 Avoidance of Occupational Diseases

9.5.1 Introduction

Several different studies were carried out pre-REACH adoption on the potential health benefits that would arise to workers (RPA, 2003; Pickvance et al, 2005), consumers and the general public (DHI et al, 2004). Given that the focus here is on substances placed on the market at between 1 and 10 tonnes per year per manufacturer or importer, we believe it is most appropriate to consider the potential benefits to workers from reductions in occupational exposures to hazardous substances. An analysis of the potential economic value of such benefits is provided below, drawing on the relevant previous work and newer information. See Table 9.1 for the results.

Mutagenicity and Carcinogenicity

Although the test data requirements under the Baseline and Options 3 to 5 are not specific to carcinogens, it should be recognised that mutagens may also be carcinogens. Thus, the identification of new mutagens will also result in the identification of new carcinogens. For example, of the 151 substances classified under the CLP Regulation 1272/2008 (Annex VI) as reprotoxins category 1A and 1B, 54 are also classified as either carcinogen category 1A or 1B or mutagen 1B, or both.

As a result, the identification of previously unknown reprotoxins or mutagens falling within the set of 1 to 10 tonne substances can also be expected to capture some previously unknown carcinogens. This is important as the benefits of introducing risk management measures to control exposures to previously unknown CMRs, particularly where these substances demonstrate more than one such property, may be considered greater than the benefits of having information on most other hazardous properties.

As indicated in Table 9.2, the baseline option is expected to identify 194 previously unknown M and R substances, with the figure increasing to 438 M and R substances under Option 5b; the reduced information requirements of Options 1 (no registration) and Option 2 (available information and physicochemical data only) would obviously not lead to the identification of any of these substance. The difference between the baseline and the other options is indicated in Table 9.5.

Table 9.5: Incremental Ms and Rs to Baseline

	Number of Previously Unknown MRs Identified	Increment in MRs compared to Baseline	Additional Carcinogens compared to the Baseline (1 C for 3 MR)
Baseline	184	0	0
Option 1	0	-184	-61
Option 2	0	-184	-61
Option 3a	196	12	4
Option 3b	204	20	7
Option 4a	166	-18	-6
Option 4b	173	-11	-4
Option 4c	166	-18	-6
Option 4d	166	-18	-6
Option 5a	349	165	55
Option 5b	390	206	69

In the case of newly identified mutagenic substances, it is difficult to establish a clear health effect that can provide the basis for valuation as part of a benefit assessment. As a result, given the strong linkage that exists between mutagenic properties and carcinogenicity, we therefore assume here that identification of these substances will lead to the future avoidance of cancer cases. Based on the data presented above on the ratio of reprotoxins to carcinogens, we assume that for every three MRs identified one of these is also a carcinogen. The resulting difference in cancer cases between the Baseline and the other options is also given in Table 9.5.

The avoidance of a cancer fatality is valued at €2 million per case, based on the value of a statistical life; the value of avoiding a non-fatal cancer is based on a willingness to pay estimate to avoid a non-fatal cancer case of €450,000 (see ECHA's Guidance on Socio-Economic Analysis Under Restrictions, 2009). Table 9.6 presents estimates of the benefits of avoiding one such cancer case for each newly identified carcinogen, or for the reduction in identified carcinogens compared to the Baseline. This includes

the value of each case on a per annum basis and the estimated value over a 20 year period (discounted at 4% to be consistent with previous impact assessments).

Table 9.6: Value of Incremental Cancer Cases Avoided

	Additional Carcinogens compared to the Baseline	Fatal cancers – € millions	Non-fatal cancers - € millions	Fatal cancers over 20 years - € millions PV	Non-fatal cancers over 20 years – € millions PV
Baseline	0	0	0	0	0
Option 1	-61	-123	-28	-1667	-375
Option 2	-61	-123	-28	-1667	-375
Option 3a	4	8	2	109	24
Option 3b	7	13	3	181	41
Option 4a	-6	-12	-3	-163	-37
Option 4b	-4	-7	-2	-100	-22
Option 4c	-6	-12	-3	-163	-37
Option 4d	-6	-12	-3	-163	-37
Option 5a	55	110	25	1495	336
Option 5b	69	137	31	1867	420

Notes: Number of cases assumes one per year per carcinogen incremental to or less than Baseline number.
Fatal cancer valued at €2 million per case; non-fatal cancer valued at €450,000 per case.
Present value costs discounted at 4% over a 20 year period.

As can be seen Table 9.6, the disbenefits (i.e. human health impacts) associated with the failure under Options 1 and 2 to identify as many carcinogens as the baseline are significant, with these valued at €375 million if the cancers are non-fatal and €1,667 million if they are fatal over a 20 year period. Per annum, these disbenefits range between €28 million to €123 million. Similarly, the disbenefits associated with the smaller numbers of carcinogens identified under Options 4a to 4c equate to between €37 million and €163 million over a 20 year period. These figures are significant and highlight the trade-offs between requiring registrants to develop more reliable data and potential future cancer cases. As will be recalled from the earlier text, Options 4a to 4c pick up a lower number of Ms and Rs as they have a more specific screening test for Ms which eliminates the number of false positives but these options do not include the additional test for R properties that are included under Option 5. As a result, Options 4a to 4c anomalously perform worse in identifying potential Ms and Rs in total than the Baseline or Option 3 which accidentally picks up more Rs due to its cruder screening of possible Ms.

For comparison purposes, RPA (2003) calculated that between 2,170 and 4,330 cancer deaths per annum may be avoided through the additional information generated on chemical properties by REACH. Further, REACH only had to identify 30 new carcinogens each giving rise to 70 cancers per annum (i.e. 210 in total) for this lower bound estimate of cases avoided to be realised. The above figures compare easily to the 2003 estimates, as they assume at most under Option 5 the avoidance of 81 cases per annum, particularly as it was anticipated that a significant number of new CMR substances would be identified in the 1 to 10 tonnage band.

Reprotoxicity

The extent to which the European workforce is actually exposed to reproductive toxicants at present is difficult to estimate. Data from Eurostat (2007) suggest that about 8.4% of the EU-27 labour force may be subject to exposure to chemicals, dusts, fumes, smoke or gas. However, the proportion of these that involve reproductive toxic agents is uncertain. Amongst Member States, only France is understood to systematically consider this. A report by Sumer (2006) report informs on a 2002-2003 survey of exposures to 4 mutagens and 14 reprotoxins for a sample of about 50,000 French workers and 1,800 occupational doctors in France. This estimated that about 180,000 workers may be exposed to reprotoxins, of which barely 4% relate to the use of reprotoxins in closed systems; men were three-times more likely to be exposed than women. Some additional information is provided by a report by RIVM for the Dutch Ministry for Public and Occupational Health (Pieters et al., 2006). Based on Eurostat data for the year 2007 and considering reproductive toxicants classified as 1A or 1B alone, it may be estimated that the numbers employed in manufacturing sectors[64] alone in the EU-27 at potential risk of exposure to reprotoxins may be in excess of 34 million, though not all workers in these sectors will actually be exposed to reprotoxins.

Of course, it must be recognised that not all reproductive toxicants in use in manufacturing and other applications have yet been identified. Indeed, this is illustrated by the raft of epidemiological papers relating to various occupational groups and industries that have reported various adverse reproductive effects but for which causative agent(s) have yet to be conclusively identified. Examples drawn from the literature on non-manufacturing sectors include: for farmers and agricultural workers, studies by Arbuckle et al (1999, 2001), Engel et al. (2000), Crisostoma and Molina (2002), Peiris-John and Wickremasinghe (2008) and Naidoo et al. (2010); for workers in the hairdressing and cosmetics sector, studies by Kersemaekers et al. (1995) and Rylander et al. (2002); and in the construction sector, a study by de Fleurian *et al.* (2009).

At present there is only limited reporting on reproductive ill-health and developmental effects (either in terms of physical abnormalities / anomalies or developmental deficits) across Europe. This significantly limits the degree to which it is possible to develop a baseline for such effects to enable a prediction of the benefits from the increased identification of new reprotoxins (or the disbenefits from failing to identify them). For example, EUROCAT - which is one of the most comprehensive networks of population-based registries of congenital anomalies, comprising 43 registries in 23 countries - only covers 29% of the European birth population (EUROCAT, undated) and there are very few datasets that inform on wider aspects of reproductive effects, such as fertility.

64 Includes: food products and beverages; textiles; leather and leather products; wood and wood products; coke, refined petroleum products and nuclear fuel; chemicals, chemical products and man-made fibres; rubber and plastic products; other non-metallic mineral products; basic metals and fabricated metal products; basic metals; fabricated metal products, except machinery and equipment; machinery and equipment; and electrical machinery and apparatus.

Thus, it is not possible at this time to estimate with any degree of certainty either the total number of workers in the EU that may be potentially at risk of exposure to chemicals possessing reproductive toxic properties or to establish the scale of reproductive impacts in workers or the wider population.

Central Nervous System Disorders

The two main types of disease of the central nervous system linked to chemicals are toxic encephalopathies and polyneuropathies, although the data may include some other disease end-points such as registered brain damage. CNS diseases can also be considered as representative of other peripheral nervous system conditions.

This set of conditions was considered in RPA (2003), with estimates on the number of cases linked to chemical exposures that could be avoided based on extrapolation from national data (as Eurostat data were not available). Using data on both total occupation related CNS diseases and reporting of only those CNS disease cases that were linked to chemical exposures are chemical related provided the basis for guesstimates of the number of disease cases that could be linked to non-specific chemical agents. The best estimates were that were that, including diseases resulting in brain damage, some 570 cases of disease linked to chemicals exposure occur in the EU in a year. Of these, about 85% are linked to non-specific chemical agents, with this suggesting a figure of about 485 cases per year. However, there is insufficient information to determine what percentage of these non-specific cases may relate to unknown chemicals. Thus, the figure of 485 cases was treated as an upper bound estimate as to the potential reduction in CNS diseases that will be achieved owing to the fuller information that will be available under REACH. A lower bound assumption of 50 cases avoided was also considered, with this correcting for a potential overlap of brain cancers being included in the source data.

The economic value assigned to the avoidance of a case of CNS disease was estimated at €11,600 per case, taking into account medical costs, lost output and human (intangible costs) (RPA, 2003).

Unfortunately, there are no data available to be able to link the avoidance of future cases of CNS to exposures to 1 to 10 tonne substances. Given this and uncertainty over the total number of cases that can be attributed to currently identified causal agents, no quantitative estimates of benefits are presented here.

Eye Disorders

For the 2003 study on occupational health benefits, more limited data were available on eye disorders associated with occupational exposure to chemicals. Only for Denmark, Finland and Sweden were there data on eye diseases resulting from chemical substances (with Sweden's figures covering chemical and biological agents). All of the data that was reported appeared to relate to incapacitation, with this suggesting that they were related to formal compensation claims for disablement. The numbers would therefore exclude cases that may cause temporary distress to workers but do not lead to lengthy incapacitation and, hence, claims for compensation.

Based on consideration of the data as a whole, it was assumed that across the EU there were likely to be around 500 cases of conjunctivitis stem from exposure to chemicals in an average year, and that 10% of these (50) stem from non-specified or unknown chemical agents.

In this case, the economic value assigned to the avoidance of a case of eye disease was estimated at €600 per case, taking into account medical costs, lost output and human (intangible costs) (RPA, 2003).

Again, unfortunately, there are no data available to be able to link the avoidance of future cases of eye disease to exposures to 1 to 10 tonne substances. Given this, no quantitative estimates of benefits are presented here.

Skin Diseases and Asthma

The model also provides estimates of the percentage of substances which would newly be found to be skin irritants, skin sensitisers or toxic to inhalation, where these would not also be CMR or PBT substances. These estimates are given in Table 9.7.

Table 9.7: Percentage of newly identified hazardous substances which are skin irritants, skin sensitisers or toxic by inhalation (excluding any substances found to also be a CMR, PBT or vPvB)

	Skin Irritants	**Skin Sensitisers**	**Toxic by Inhalation (new classes only identified under 'b' options - others do not include the test)**
Percentage of substances newly identified with any ENV/HH classification	44%	9%	59%

In their study for the ETUI on the occupational health benefits of REACH, Pickvance et al (2005) derive an economic value for the avoidance of both occupational eczema/dermatitis and asthma.

Pickvance et al (2005) assumed that the health care costs of hand eczema (used here as a proxy for dermatitis) will comprise the costs of both visits to general practitioners and the costs of medication. Based on figures given in ECHA's Restrictions SEA Guidance document, a cost per visit with a primary care physician is estimated at around €57 per consultation, with an average of just over two visits occurring per year; we therefore assume a cost of around €115. Medication costs are assumed to add a further €10 per annum, for a total cost per case of skin disease of €125 per annum.

Pickvance et al (2005) also included estimates of the productivity costs associated with a case of occupational contact dermatitis. They assumed that the average number of days' sick leave is 3 per case, with this translating to an annual cost of roughly €280. If a further 20% decrease in earning capacity is assumed for those reporting impacts on productivity due to occupational dermatitis, then an additional €1,000 – €4,000 can be added to the productivity cost estimates. Adding the two sets

of figures together gives combined health care and productivity costs of between around €1,400 and €4,400 per year per case of occupational contact dermatitis.

A further element for the value of the lost health related quality of life associated (i.e. reduction in QALY score) with occupational skin diseases was then included by Pickvance et al (2005), with this based on a range from 0.05 to 0.2 QALYs quoted in the academic literature. The monetary value of a QALY was then assumed to be between €28,000 – €43,000 (based on the implicit threshold used by NICE in the UK). Combining these figures with the number of QALYs lost resulted in estimated economic losses of between €1,400 – €8,600 per year.

A similar exercise was carried out for asthma, with this resulting in health care costs of around €225 per case, productivity losses of around €2,200 and the value of lost QALYs being between €1,400 – €8,600 per year.

Added together, the above data suggests a total figure per disease case avoided of between €4,000 and €9,000 per year. We take the lower figure of €4,000 for the analysis carried out here, to err on the conservative side.

From the evidence that they examined, Pickvance et al (2005) calculated that the incidence per million per year without REACH for asthma and dermatitis was 400 for both, of which the proportion of cases potentially preventable by REACH is 50%, 10% and 50%, respectively. Using a working population figure for EU-25 of 200 million, the number of future cases per year that might be avoided thanks to REACH was then estimated as being 40 000 for asthma and 40 000 for dermatitis. These data are presented in Table 9.8.

Table 9.8: Incidence, Proportion and Number of Cases Avoided by REACH

	Incidence: nr. of cases / million / year	**Proportion of cases avoided by REACH**	**Nr. of cases per year avoided by REACH**
Asthma	400	50%	40,000
Dermatitis	400	50%	40,000
Source: Pickvance et al, 2005			

From the data presented in Pickvance et al (2005) it is not possible to determine what proportion of the 40,000 cases might be linked to exposures of 1 to 10 tonne substances. RPA (2003) found that some 3,680 cases of respiratory diseases (including asthma) could be linked to unknown and non-specific chemical agents. Given that exposures to 1 to 10 tonne substances should be limited by the nature of the low volumes alone, we assume here that only a small percentage of the cases calculated by Pickvance et al would be reduced by the availability of better data on this set of substances.

Thus, in order to be conservative, we assume that the data generated under Annex VII on skin sensitization and skin irritation would result in 1000 cases of dermatitis being avoided due to better information on substance properties. This would apply under the Baseline, Options 3, 4 and 5. In addition, due to the further information requirements under Options 5a and 5b in particular (on inhalation toxicity and dermal

toxicity), we assume that 2000 cases of each would be avoided. These figures are low given the numbers of substances predicted as being newly identified as having new classifications as reported in Table 9.1, when combined with the percentages indicated in Table 9.7. However, they also reflect the fact that repeated exposures to such low volume substances may limit the number of disease cases.

Table 9.9 presents the results of combining these assumptions, while Table 9.10 then provides an indication of the differences between the options with respect to the end benefits.

Table 9.9: Estimated benefits of reductions in asthma and dermatitis cases

Disease	€ per case	Number of cases per annum	Benefits € million PV
Annex VII data			
dermatitis	4,000	1,000	54.4
Annex VIII data			
asthma high	4,000	2,000	108.7
dermatitis high	4,000	2,000	108.7
Total			217.4

Notes: Benefits discounted at 4% over 20 years for consistency with previous assessments.

Table 9.10: Value of Incremental Benefits for Asthma and Dermatitis Compared to Baseline

Option	Benefits € million PV	Incremental Difference to Baseline
Baseline	54.4	0
Options 1 and 2	0	- 54.4
Options 3a and 3b	54.4	0
Options 4a and 4b	54.4	0
Options 4c and 4d	indeterminate	indeterminate
Options 5a and 5b	217.4	163.1

As can be seen from Table 9.10, Options 1 and 2 would result in a loss of health benefits compared to the Baseline due to the failure to identify potential dermal irritants and sensitisers, assumed here to translate to the loss of 1000 such cases being avoided per annum. It is not possible to determine the difference in cases avoided between the Baseline and Options 4c and 4d, as it is not possible to make a link here between the identification of CMRs and PBTs/vPvBs under these two options and the concomitance of either dermatitis or respiratory effects. However, as noted above, because Options 5a and 5b include further tests for inhalation and dermal toxicity, these are expected to result in further reductions of future cases of dermatitis and asthma (or other respiratory effects). The estimated benefits of having the additional information (both endpoint and CSA related) produced by these options so as to avoid future cases are €163 million over the Baseline.

9.6 Other Avoided Damages / Benefits

The above analysis has not addressed the potential environmental benefits associated with better information on ecotoxicity, persistence and bioaccumulation data for 1 to 10 tonne substances. Given the volume of these substances that might be released to the environment, it is unlikely that impacts would arise at the regional level. They could arise at the local level though and, in this respect, a PBT substance could cause significant damages, the remedy of which could entail significant economic costs.

There may also be other benefits of requiring the registration of 1 to 10 tonne substances; these include for example market harmonization benefits, given that REACH is an internal market regulation.

10. SUMMARY COMPARISON OF BENEFITS AND COSTS

10.1 Overview

This study has examined a range of options involving reduced information and extended information requirements for the registration of substances manufactured or imported only at 1 to 10 tonne substances under REACH. In total, eleven different options have been considered:

- The Baseline: Current requirements under Article 12 and Annex III of REACH;
- Option 1 - No registration for substances manufactured or imported in quantities between 1 and 10 tonnes;
- Option 2 - Annex VII physicochemical data only;
- Option 3a - data on all Annex VII endpoints for hazardous substances:
- Option 3b - data on all Annex VII endpoints for all the substances:
- Option 4a - data on all Annex VII endpoints plus selected endpoints from Annex VIII for hazardous substances;
- Option 4b - data on all Annex VII endpoints and selected endpoints from Annex VIII for all the substances;
- Option 4c - No registration for non-CMR substances;
- Option 4d - No registration for non-CMR, non-PBT or non vPvB substances;
- Option 5a - data on all Annex VIII endpoints for hazardous substances; and
- Option 5b - data on all Annex VIII endpoints for all the substances.

The options are described in more detail in Section 7, together with the model used to assess the associated costs and to predict the number of substances that would be newly identified as having hazardous properties. Sections 8 and 9 discuss the results of running the model, presenting the estimated costs and findings with respect to newly identified hazardous substances respectively. They also discuss related issues such as the potential impacts of the options on innovation and competition, with a focus on micro and small enterprises, and on the potential benefits in terms of the reduction of future disease cases. In this respect it is important to note that while the costs and benefits discussed here relate only to those substances registered in the 1 to 10 tonnage band, the impacts of extending or reducing information requirements would fall on all registrants registering substances in this particular tonnage range.

This section brings together information on costs and benefits to enable a comparative assessment. It starts by examining the relative cost-effectiveness of each of the options, with this bringing together the total costs and numbers of substances having different types of hazardous properties identified as a result of the proposed data requirements. We then summarise further cost and benefit considerations for each of the options to better enable a comparison of their advantages and drawbacks.

10.2 Cost-Effectiveness of Options

10.2.1 Average Total Costs

Details of the total costs by option were provided in Section 8. These figures are repeated here together with further information on the total costs per substance and the total average costs per registrant per substances (where this takes into account the fact that there may be multiple registrants of some 1 to 10 tonne substances).

Table 10.1: Total Costs by Substance and Registrant

	Total Costs (€ million)	**Total average costs per registered substance (€)**	**Total average costs per registrant (€)**
Baseline	168	9,590	6,830
Option 1	0	0	0
Option 2	119	6,810	4,850
Option 3a	210	11,990	8,530
Option 3b	248	14,190	10,100
Option 4a	601	34,330	24,430
Option 4b	26	1,510	1,080
Option 4c	823	47,020	33,460
Option 4d	22	1,260	890
Option 5a	1,877	107,280	76,340
Option 5b	2,313	132,150	94,030

As 1 to 10 tonne substances would not have to be registered under Option 1, this is clearly the lowest cost of all of the options, followed by Options 4c and 4d which make use of screening information to determine the number of substances that would have to go through registration. As can be seen from the above estimates, the total average costs per substances decrease significantly when moving from the current baseline requirements to either of these options; Option 4d is associated with slightly higher costs than Option 4c due to the additional need to screen for PBTs as a trigger to registration (with this also identifying additional substances requiring registration).

Interestingly, Option 2 with its reliance on physicochemical information only does not result in as significant reductions in the total average cost of registering a substance as might initially be anticipated due to the heavy reliance on QSARs and read across

under the other options. It is also of note that the costs under the Baseline are significantly lower than those under either Options 3a or 3b, although the latter are only between €2,100 and €4,300 more expensive on a per substance basis with the difference in costs per registrant being slightly lower.

As might be expected, Options 4a and 4b followed by Options 5a and 5b are significantly more expensive than the other options. In this case, the costs per registered substance under 4a and 4b range from between €34,000 and €47,000, with the average costs per registrant ranging from between €24,000 and €33,500. These figures rise to between €107,000 and €132,000 as an average per registered substance for Options 5a and 5b respectively, and between €76,000 and €94,000 per registrant.

This increase is due to the cost of the additional tests required, i.e. for option 4a and 4b the increase is driven by the cost of the mutagenicity tests (€28,000) and repeat dose toxicity tests (€50,000), while for option 5a and 5b the increase is driven by the reproductive toxicity test cost (around €110,000).

Table 10.2 below shows the statistical average costs to register a substance manufactured or imported in quantities of between 1 and 10 tonnes by company size under each option.

Table 10.2: Total Average Costs per Substance by Company Size

	Micro enterprise	Small enterprise	Medium enterprise	Large enterprise
Baseline	9,300	19,300	45,000	97,700
Option 1	0	0	0	0
Option 2	5,400	12,300	30,900	72,600
Option 3a	11,800	23,600	54,500	119,400
Option 3b	14,000	28,400	65,100	140,800
Option 4a	34,100	68,800	158,800	351,500
Option 4b	45,600	96,200	219,600	478,000
Option 4c	900	2,200	5,700	13,500
Option 4d	1,200	2,800	6,700	16,300
Option 5a	106,000	220,700	506,300	1,083,000
Option 5b	128,200	272,300	625,600	1,333,300

For microenterprises, considering the case study in Section 8.2.2 and taking into account their classification criteria of less than 10 employees and a turnover of less than €2 million, these costs are high. It is understood from consultation for other REACH related work, that although not a provision within the Regulation, downstream users have helped some manufacturers support essential chemicals through REACH already. If downstream users were not willing to share such costs under Options 5a and 5b, it may be more difficult for microenterprises to meet the estimated registration costs. They would have to plan the registration some years in advance of the 2018 deadline, with this implying that testing would also have to be carried out over time in order to amortise the costs. As stated in the CSES study, highly innovative exporting SMEs that concentrate on relatively few product lines may unable to spread the costs to non-REACH affected products in their business portfolio, making them vulnerable to competition from non-EU countries in export markets.

This would be true also for the import company described in the case study for small enterprises. In that case, if the manufacturers based abroad would not be willing to share the registration costs, the case study company could choose to stop the imports of some of the substances (in the example, colours for textiles, tanning and paper industry). This could affect their market share but also impact their downstream users, in terms of higher prices to purchase the same products from other manufacturers/importers or in terms of range of products in their portfolio in the case those substances are not available anymore on the EU market, resulting in a potential loss of innovation and competitiveness against non-EU companies. Indeed, the textile industry is especially concerned about the withdrawal of low production volume substances, believing that possible substitutes and reformulation changes could impede the quality of the overall product[65].

As found by the consultation conducted for the CSES study, medium and large companies, having a broader range of substances, could consider to rationalise their products portfolio, withdrawing some of the substances in consideration of both financial costs of registering and of the hazardous properties of the substances.

10.2.2 Cost-Effectiveness

The increased costs as one moves up the options is accompanied by more extensive and reliable information on the hazard properties of 1 to 10 tonne substances. Table 10.3 provides summary data on number of substances newly identified as having different properties of concern under each of the options, indicates the costs per newly identified substance and then ranks the options in terms of their cost-effectiveness.

These cost-effectiveness results are interesting for two reasons. Firstly, they highlight an interplay between the Baseline and Options 4c and 4d which both incorporate screening requirements prior to triggering the need for registration; in both cases, registration requirements would then relate to Annex VII and selected Annex VIII data together with the need to prepare a Chemical Safety Assessment. Option 4c is focused on screening for M and R properties (as there is no test endpoint specific to C in Annex VII or VIII) while Option 4d adds screening for PBT and vPvB properties. Note that, under these two Options, there is no screening for other human health or environmental classifications, nor a trigger related to diffuse use, as exists currently in Annex III of REACH.

As a result, Options 4c and 4d perform better than the Baseline option when it comes to their cost-effectiveness in identifying substances with M and R properties, but perform much worse if other human health and environmental classifications are also a key focus. Furthermore, because these options are so targeted, they are much more cost-effective than Options 5a and 5b which would produce more reliable data and identify significantly more M and R substances.

[65] N.a.. (2005): *Analysis of the Potential Impacts of Reach on European Textile Supply Chains": Final Report.*

Table 10.3: Summary Data on Cost-effectiveness and Option Ranking									
	Number of already classified substances where new classifications found	**Number of previously unknown substances with any new health or environmental classification**	**Number of Previously Unknown MRs Identified**	**Number of Previously Unknown PBT/vPvB Identified**	**Total Costs (€ Million)**	**Cost per New substance with classification identified (€ Million)**	**Cost per New Actual PBT/vPvB and CMR identified (€ Million)**	**Rank New substance with classification identified**	**Rank New Actual PBT/vPvB and CMR identified**
Baseline	120	8,309	184	19	€ 167.89	€ 0.02	€ 0.8	1	3
Option 1	0	0	0	0	€ 118.66	€ 0.00	€ 0.0	10	10
Option 2	0	0	0	0	€ 119.20	€ 0.00	€ 0.0	10	10
Option 3a	125	8,310	196	21	€ 204.96	€ 0.02	€ 0.9	2	4
Option 3b	125	9,532	204	22	€ 243.21	€ 0.03	€ 1.1	3	5
Option 4a	183	8,265	166	11	€ 600.77	€ 0.07	€ 3.4	4	6
Option 4b	183	9,599	173	11	€ 822.91	€ 0.09	€ 4.5	5	7
Option 4c	0	82	166	11	€ 21.98	€ 0.27	€ 0.1	8	1
Option 4d	0	92	166	0	€ 26.49	€ 0.30	€ 0.2	9	2
Option 5a	1826	10,341	349	17	€ 1,877.44	€ 0.18	€ 5.1	6	8
Option 5b	1826	11,902	390	17	€ 2,312.68	€ 0.19	€ 5.7	7	9

The Baseline option would identify over 8,300 substances as having new environmental or human health classifications and a higher number of M and R substances, but at a higher overall cost and thus lower cost-effectiveness. However, the Baseline would also be associated with a high number of false positive outcomes which would need to be resolved by registrants. It is likely that many registrants would turn to testing in order to resolve the uncertainties over the classification of these substances, with this suggesting that the costs actually incurred under the Baseline would be higher than those predicted here.

The potentially high number of false positive outcomes under the Baseline also holds for Options 3a and 3b, which come after the Baseline in the rankings. Again, this suggests that the actual costs may be more than those predicted by the model, which takes into account only those costs specifically associated with fulfilment of each option's requirements.

The question then arises as to whether, even with the additional testing that registrants may need to undertake to resolve such issues, these options would be lower cost in practice than Options 4 or 5. The answer to this is that Option 4a has been designed to include the tests from Annex VIII that would have to be run by registrants in order to correct for the high number of false positive outcomes under the Baseline and Options 3a and 3b (with these being 1,100 for M and R and over 600 for PBT/vPvB based on the use of QSARs, read across and available data). Thus, the actual costs under the Baseline, Option 3a and 3b may be much closer to those for Option 4a, with the key difference being no requirement to also prepare a CSA (as is assumed under Option 4a where Annex VIII endpoints are identified).

Based on data from Cefic and other sources, the estimated costs of carrying out tests so as to clarify whether or not a substance is a M or an R under Annex VIII are around €100,000 to €150,000. Recent reports indicate that the starting point for the price of fine or speciality chemicals is around €10,000 per tonne[66], with searches for market prices for specific chemicals suggesting a figure of around €20,000 per tonne would be reasonable, then it could clearly take many years to recover the costs of undertaking such tests unless downstream users are willing to contribute to the costs of registration or it is possible to increase the price charged per tonne of substance sold due to an inelastic demand.

As noted in Sections 8 and 9, substance withdrawal can have significant implications for downstream users. It can lead to a cessation of some activities where critical inputs are lost or to significant reformulation costs where it is possible to find an alternative. Even when reformulation is possible, increases in costs may lead to some activities (or companies) no longer being competitive and hence the loss of production within the EU. Of course the degree to which such outcomes would be associated with 1 to 10 tonne substances is unknown, although many sectors have raised concerns in the past over the loss of speciality low volume substances for the on-going viability of their activities.

[66] Pollak, P (2011): Fine Chemicals: The Industry & the Business, Wiley.

10.3 Costs versus Benefits

Following on from the above discussion, there is clearly a range of different trade-offs involved in choosing between the eleven options considered here. Section 9 provided a discussion on the types of human health and environmental benefits that could stem from the information that would be developed under each of the options. This included both qualitative descriptions and quantification of potential benefits related to the new identification of mutagens and reprotoxins, which are also likely to be carcinogens, and skin and respiratory irritants/sensitisers. These estimates are reproduced in Table 10.4 to provide an indication of the total present value benefits estimated for each option in terms of reduced future health effects. Table 10.5 follows this by combining estimates of total costs with total benefits to calculate net effects.

Table 10.4: Estimated Total Benefits from Reduction of Human Health Impacts

Option	Benefits of fatal cancer avoidance (€ million)	Benefits of non-fatal cancer avoidance (€ million)	Benefits of avoided dermatitis cases (€ million)	Benefits of avoided respiratory cases (€ million)	Total benefits – assuming fatal cancers (€ million)	Total benefits – assuming non-fatal cancers (€ million)
Baseline	1667	375	54	0	1721	429
Option 1	0	0	0	0	0	0
Option 2	0	0	0	0	0	0
Option 3a	1776	400	54	0	1830	454
Option 3b	1848	416	54	0	1902	470
Option 4a	1504	338	54	0	1558	392
Option 4b	1568	353	109	109	1786	571
Option 4c	1504	338	54	0	1558	392
Option 4d	1504	338	54	0	1558	392
Option 5a	3162	712	109	109	3380	930
Option 5b	3534	795	109	109	3752	1013

Notes: Benefits discounted at 4% over 20 years to be consistent with previous assessments.

Table 10.5: Costs versus Benefits

Options	Total costs (€ million)	Total benefits – assuming fatal cancers (€ million)	Total benefits – assuming non-fatal cancers (€ million)	Benefits Minus Costs – assuming fatal cancers (€ million)	Benefits Minus Costs – assuming non-fatal cancers (€ million)
Baseline	168	1721	429	1553	261
Option 1	0	0	0	0	0
Option 2	119	0	0	-119	-119
Option 3a	205	1830	454	1625	249
Option 3b	243	1902	470	1659	227
Option 4a	601	1558	392	957	-208
Option 4b	823	1786	571	963	-252
Option 4c	22	1558	392	1536	370
Option 4d	26	1558	392	1532	366
Option 5a	1877	3380	930	1503	-948
Option 5b	2313	3752	1013	1439	-1300

As can be seen from Table 10.4, all options other than Option 1 and 2 deliver net benefits in terms of the avoidance of future cancer cases (where these are assumed to be fatal) and occupational skin and respiratory diseases. The highest level of net benefits are delivered by Options 3a and 3b where disease avoidance relates to fatal cancer cases, and Options 4c and 4d where it relates to non-fatal cancers. Interestingly, on the conservative assumptions made in Section 9 with respect to the avoidance of future cancer cases and future cases of skin and respiratory disease, the increased costs associated with Option 5a and 5b are not outweighed by the estimated benefits.

Table 10.6 helps make the differences between the Baseline and the various options clearer. There are clear variations in the performance of the options depending on whether one assumes all future cancers avoided would be fatal rather than non-fatal. However, on the basis of the diseases considered here, Option 1 and 2 are non-favoured compared to the Baseline, as would be Options 4a and 4b, and Options 5a and 5b. Otherwise, it is more difficult to draw clear conclusions from these figures. It should be noted though that small incremental differences between options should not necessarily be considered significant given the probabilistic nature of the model and the uncertainties in the underlying data (including the valuation of a fatal and non-fatal cancer and estimates of the number and value of avoiding skin and respiratory diseases). Furthermore, as emphasised above, the fact that costs under the Baseline and Options 3a and 3b are likely to be higher than assumed here due to registrants wishing to resolve false positive QSAR and read across outcomes would have an effect on these incremental net benefit calculations.

Table 10.6: Incremental Net Benefits over the Baseline

Options	Benefits Minus Costs (€ million)		Incremental Net Benefits over Baseline (€ million)	
	Fatal cancers	Non-fatal cancers	Fatal cancers	Non-fatal cancers
Baseline	1553	261	0	0
Option 1	0	0	-1553	-261
Option 2	-119	-119	-1672	-380
Option 3a	1625	249	72	-13
Option 3b	1659	227	106	-35
Option 4a	957	-208	-596	-470
Option 4b	963	-252	-591	-513
Option 4c	1536	370	-17	109
Option 4d	1532	366	-22	105
Option 5a	1503	-948	-50	-1209
Option 5b	1439	-1300	-114	-1561

What also becomes clear from the above calculations is that other refinements could be carried out on some of the options considered here. For example, Options 4a, 4b, 5a and 5b do not include the "any other human health and environmental classification AND dispersive or diffuse use" hurdle that is included in the Baseline. If the dispersive /diffuse use hurdle was included in these options, then their testing and registration costs would reduce. Similarly, new Options 5c and 5d could be

developed which would perform in a similar manner to Options 4c and 4d, albeit at a higher costs but also resulting in the identification of a higher number of new hazardous properties in relation to any human health or environmental classification, as well as mutagens and reprotoxins and PBT/vPvBs.

10.4 Other Factors

The above discussion has considered the estimated total costs of each option as well as human health benefits in terms of the avoidance of a sub-set of (illustrative) diseases linked to exposures to industrial chemicals. There are a series of other factors which should also be taken into account. These can be summarised as follows:

- **Internal market**: REACH is an internal market regulation, and is intended inter alia to ensure that there are no barriers to trade across the EU in terms of variations in the requirements of Member States on the registration and use of industrial chemicals. As a result, there may be indirect impacts on some actors under Option 1 should the requirement for the registration of substances manufactured or imported at between 1 and 10 tonnes be removed from the regulation with national governments responding by establishing their own information requirements on the basis of the need to protect human health and the environment. This may impact upon the competitiveness of smaller chemical manufacturers in particular, as it may make it harder to export chemicals across national boundaries.

- **Wider health and environmental benefits**: The assessment of benefits was only able to consider a sub-set of potential health effects, and these only in terms of occupational health. Given the potential for additional health benefits from the identification of additional concerns under Option 4b and 5 (and 5b in particular), the benefits reported here are likely to be underestimates but serve to illustrate the relative effectiveness of the various options. No attempt has been made to try and quantify potential benefits to consumers or the general public. This is important as there may be benefits from reduced exposures for consumers in particular, where a substance is found to have M and R properties for example, depending on exposure patterns.

  With respect to the environment, the identification of new PBTs (in particular) and vPvBs may help avoid long term damage to the environment. It has not been possible to include any quantified measure of the benefits of avoiding these in this assessment given that, for the production volumes considered here, such damages are most likely to arise at the local level; but the fact that effects may occur on a broader basis should not be entirely dismissed given the P and B characteristics of these chemicals.

- **Innovation**: The issue of innovation was examined in Section 8 in relation to the costs arising under the different options. Clearly, the lower the costs to industry the lower the likely knock-on effects for innovation, assuming that there remains a

level playing field across the EU with regard to national requirements. This suggests that Options 4c and 4d may have the lowest impact on innovation, followed by Option 2 and then the Baseline. However, there is likely to be little difference in effects between the Baseline and Option 3. This conclusion with respect to the Baseline and Option 3 assumes though that registrants do not decide to test rather than rely on QSAR and read across information so as to avoid false positive declarations of M, R, PBT and vPvB properties. Given the significant increases in costs associated with Options 4a and b and 5a and b, these options are assumed to give rise to the most significant impacts on innovation.

The withdrawal of substances from the market, for example, in response to the total costs of registration or due to false positive indications of hazardous properties could have knock-on effects for the level of innovation in downstream user sectors. This is because substance withdrawal may remove critical inputs from the market or may result in costly reformulation activities, with these acting as a diversion of research and development expenditure in the affected sectors.

This is illustrated by the results of the CSES Innovation Survey, to which 63% of respondents said that that the requirements of the REACH regulation had diverted resources from 'truly' innovative research. Indeed, for a fairly stable set of companies (roughly 30% but varying by size and cost item), the registration fees, testing costs, dossier preparation costs and resource costs associated with supply chain communication had resulted in a significant diversion of resources away from innovative activities. Although 46% of respondents to the CSES Innovation Survey indicated that there had been an overall increase in expenditure on R&D and other innovative activities, this was primarily due to factors outside REACH that have a greater impact on innovation than the Regulation itself (e.g. the state of markets and technology). Overall, though, the CSES report concludes that it is still too early to assess the impacts of REACH in relation to innovation.

- **Competitiveness**: Competitiveness concerns arise at three different levels. The first is the potential impact which registration costs may have on the ability of micro, small and medium sized enterprises to continue the manufacture and supply of 1 to 10 tonne substances within the EU, as discussed above (and in Section 8.

  At the second level, the costs of registering 1 to 10 tonne substances and the need for registrants to pass these downstream to their customers may increase the costs of producing other goods and services in the EU. This may therefore impact on the competitiveness of the chemicals sector (in terms of extra-EU exports) as well as downstream user sectors in placing their products on the global market.

  Substance withdrawal, and the loss of critical inputs, may also impact upon the competitiveness of EU industry vis a vis producers in other countries.

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ANNEX 1:

LINKAGES TO OTHER LEGISLATION

A1.1 Introduction

This Annex complements the summary analysis, provided in Section 7 of this report. Annex I includes an examination of the data requirements under each piece of legislation against a) the data requirements for 1 to 10 tonne substances, and b) the data requirements for 10 to 100 tonne substances. For pieces of legislation with a high demand for data, the analysis is accompanied by a series of tables. Where the demand for data under REACH is low, the tables are omitted. Where the demand for data is unlikely to be met by the lower availability of data for 1 to 10 tonne substances, this is discussed. In addition, Annex I identifies where data on substances is generated under specific pieces of EU legislation. This comprehensive review served to inform other aspects of the overall analysis under this study.

A1.2 Legislation on the Health and Safety of Workers

A1.2.1 Directive 98/24/EC on Chemical Agents

Directive 98/24/EC[67] on the protection of the health and safety of workers from the risks related to chemical agents at work (CAD) requires employers to determine whether any hazardous chemical agents are present at the workplace and assess any risk to the safety and health of workers arising from the presence of those chemical agents. As such, the scope of the CAD is broad, covering the assessment and control of all physicochemical and human health risks to workers. Environmental hazards and risk are outside of the scope, as are impacts on the environment, on humans via the environment and on consumers.

Given the lower production volumes for 1to 10 tonne substances, it can be assumed that fewer workers overall will be exposed to these substances than high production volume substances. However, significant exposure of workers involved in specific applications cannot be ruled out, in which case the demand for data on 1to 10 tonne substances becomes highly relevant.

Employers will draw on REACH Safety Data Sheets (SDS) provided by suppliers to identify hazardous substances in the workplace. Employers then combine this hazard data with exposure data generated for specific workstations to assess the risk to individual workers. The SDS should also list the national exposure and biological limit values set in accordance with the CAD. Moreover, the information on exposure control under REACH can be used for the risk assessment carried out by the employer under the CAD. The Commission has issued a guidance document for employers on controlling risks from chemicals concerning the interface between the Chemicals

[67] Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC), OJ L 131, 5.5.1998, p. 11–23.

Agent Directive and REACH at the workplace. [68] It states that while the obligations of the CAD continue to apply after the adoption of the REACH Regulation, there is no duplication between the two acts. It is also observed that one risk assessment can often meet the requirements of both REACH and CAD.

With regard to data available for 1 to 10 tonne substances classified as hazardous under CLP, the risk assessment may suffer from information gaps in relation to some hazard endpoints (in particular carcinogenicity, reprotoxicity and repeat dose toxicity). For non-Annex III phase in 1 to 10 tonne substances, no toxicity data will be available and employers will not be in a position to identify possible hazards. The information requirements for 1 to 10 tonne phase in substances that do not meet the Annex III criteria are limited to the physicochemical properties, with no requirement for toxicity data.

Regarding available data on risk management measures, for substances that are hazardous, PBT, vPvB or on the Candidate List of Substances of Very High Concern (SVHC) but that are on the market at below 10 tonnes, the SDS will not include exposure scenarios or a risk assessment, meaning that employers and workers will have less information available from REACH registrations to inform the development of risk management measures.

In terms of data generation under the CAD, employers are not required to generate new hazard data, but are required to generate site specific data on workers' exposure to chemical agents at specific work stations.

The CAD requires the evaluation of the relationship between the health effects of hazardous chemical agents and the level of occupational exposure in order to propose indicative occupational exposure limit values (IOELV) for the protection of workers from chemical risks. These limit values are set at EU level by the Commission. Member States should then set national occupational exposure limit value, taking into account the Community limit value. The implementing Directive 2000/39/EC establishes a first list of 63 substances with IOELVs, while Directive 2006/15/EC establishes a second list of 33 substances with IOELVs, and Directive 2009/161/EU establishes a third list of 19 substances with IOELVs. In addition, binding biological limit values may be drawn up at Community level on the basis of the evaluation described above and of the availability of measurement techniques, and shall reflect feasibility factors while maintaining the aim of ensuring the health of workers at work. Binding occupational exposure limit values may also be drawn up at Community level. Member States shall then establish a corresponding national binding OEL. If a binding biological limit value is established, Member States shall establish a corresponding national binding biological limit.

[68] Guidance for employers on controlling risks from chemicals, Interface between Chemicals Agents Directive and REACH at the workplace, European Commission, October 2010, link available at: http://ec.europa.eu/social/main.jsp?catId=716&langId=en&intPageId=223

The information requirements for the operation of the Chemical Agents Directive and any provisions for the generation of additional information are summarised in Table A1.1 below.

A1.2.2 Directive 2004/37/EC on Carcinogens and Mutagens

The Carcinogens and Mutagens Directive 2004/37/EC[69] (CMD) sets specific risk management measures for workers exposed to carcinogens and mutagens. The scope of the carcinogens and mutagens Directive is specifically focussed on the carcinogenic and mutagenic properties of substances and associated risks to workers' health. As with the Chemical Agents Directive, environmental hazards and risk are outside of the scope, as are impacts on the environment and consumers.

Employers will identify carcinogens and mutagens category 1A and 1B using the SDS generated under REACH and provided to the employer by suppliers.

Regarding the availability of information to inform subsequent risk management, for substances that are carcinogenic or mutagenic and that are manufactured and/or imported in quantities below 10 tonnes, the SDS will not draw on a CSA to include exposure scenarios or a risk management measures, meaning that the employer and worker will have less information available to develop risk management measures.

In terms of generating new data, employers are required to generate new data on the workers exposure to chemical agents on site (i.e. level type and duration of exposure). There is no requirement to generate additional data on hazard or on exposure more generically (i.e. environmental exposure).

Table A1.2 below summarises the information requirements for the operation of the CMD and any provisions within the CMD for the generation of additional information.

A1.2.3 Directive 94/33/EC on Young Workers

The Young Workers Directive 94/33/EC[70] takes a two-tiered approach to protecting young workers from exposure to chemical agents. Firstly, employers are obliged to assess the hazards to young people, involving the identification of chemical hazards with respect to chemical agents in the workplace. They must then generate new site-specific data on the nature, degree and duration of exposure to chemical agents. Employers shall then adopt the measures necessary to protect the safety and health of young people. In particular, work involving the exposure of young people to agents to certain categories of substances is prohibited, namely substances that are toxic,

[69] Directive 2004/37/EC of the European Parliament and of the Council of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work (Sixth individual Directive within the meaning of Article 16(1) of Council Directive 89/391/EEC) (codified version) (Text with EEA relevance), OJ L 158, 30.4.2004, p. 50–76.

[70] Council Directive 94/33/EC of 22 June 1994 on the protection of young people at work, OJ L 216, 20.8.1994, p. 12.

carcinogenic, cause heritable genetic damage or harm to the unborn child or which in any other way chronically affect human health.

Employers will therefore draw on data on the hazard properties of substances in the workplace to determine whether these trigger a prohibition of exposure for young workers. The Directive does not demand data on environmental hazards or on possible risks to consumers.

The REACH SDS will represent the key information source for identifying chemical hazards. Regarding data provided under the registration requirements for 10 tonne substances, some gaps can be identified. For 1 to 10 tonne phase in substances that do not meet the criteria of Annex III, no data will be available on toxicity. For all other 1 to 10 tonne substances, no information will be available on carcinogenicity, repeat dose toxicity, or reproductive toxicity.

The information requirements for the operation of the Young Workers Directive and any provisions for the generation of additional information are summarised in Table A1.3 in Annex 1.

A1.2.4 Directive 92/85/EEC on Pregnant Workers

The Pregnant and Breastfeeding Workers Directive 92/85/EEC[71] requires the employer to conduct a risk assessment to the nature, degree and duration of exposure to certain types of chemical agents in so far as it is known that they endanger the health of pregnant women and the unborn child. The risk assessments apply to substances and mixtures, and require assessment of risks to vulnerable workers from substances generated in the workplace that REACH may not cover (e. g. substances exempted from REACH under, for example in Annex V, substances manufactured or imported < 1 tonne or process generated such as wood dust). It focuses on the risks to a specific group of workers, and does not demand data on environmental hazards or on possible risks to consumers.

This Directive sets risk management measures to limit the exposure of pregnant workers, workers who have recently given birth and or who are breastfeeding to certain hazardous chemicals. The risk management measures vary depending on whether the exposure is to chemical agents listed in Annex I or to chemical agents listed in Annex II (lead and lead derivatives), with work prohibited in the later case.

For chemical agents set in Annex I (non exhaustive list):

the employer shall assess the nature, degree and duration of exposure;
he/she shall assess any risks to the safety or health and any possible effects on the pregnancy or breastfeeding of workers; and

[71] Council Directive 92/85/EEC of 19 October 1992 on the introduction of measures to encourage improvements in the safety and health at work of pregnant workers and workers who have recently given birth or are breastfeeding (tenth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC), OJ L 348, 28.11.1992, p. 1.

he/she shall then decide what measures should be taken:

- adjustment of the working conditions and or working hours to avoid exposure; or
- granting of leave if adjustment not possible.

In determining whether Annex I chemicals are present in the workplace, although no specific hazard assessments are required under this Directive, in principle the employer must determine if any of the substances used meet the Annex I criteria. Annex I includes categories of substances labelled R 40, R 45, R 46, and R 47 under Directive 67/548/EEC (now CLP). It can be expected that employers will rely on data generated under REACH and communicated through the SDS. For 1 to 10 tonne substances, registration will not generate information on the carcinogenicity of substances, repeated dose toxicity, reproductive toxicity, although information may be available through other sources. A hazard assessment is also required for substances identified under Annex I of the Carcinogens and Mutagens Directive, (although the text refers to the former Directive 90/394/EEC) although here the classification of the substance is not in question.

These risk management measures are most likely to be based on the information generated under REACH (e. g. information from the SDS on occupational exposure controls). For substances that endanger the health of pregnant women and the unborn child but that are on the market at below 10 tonnes, the SDS will not include exposure scenarios or a risk assessment, meaning that the employer will have less information available to develop risk management measures. Where risk management measures are available for higher tonnage thresholds, they are unlikely to consider the specific vulnerabilities of pregnant workers and breastfeeding workers.

If the results of the risk assessment mentioned above reveal a risk to the health or safety or an effect on the pregnancy or breastfeeding of one of the workers, the employer needs to ensure that the exposure to these risks is avoided (e.g. by temporarily readjusting the working conditions and/or working hours of that worker).

Given the lower production volumes for 1 to 10 tonne substances, it can be assumed that fewer pregnant or breastfeeding workers overall will be exposed to 1 to 10 tonne substances than to high production volume substances. However, the exposure of pregnant or breastfeeding workers involved in specific applications cannot be entirely ruled out, in which case the demand for data on 1 to 10 tonne substances becomes highly relevant in determining whether risk management is required and whether there is a risk to health or safety or an effect on the pregnancy or breastfeeding. For employers of pregnant workers, it is particularly notable that data will not be made available under REACH on reproductive toxicity for 1 to 10 tonne substances, while regarding breastfeeding workers, the absence of data on repeated dose toxicity and carcinogenicity is limiting.

For lead and lead derivatives set out in Annex II, pregnant workers and workers who are breastfeeding may under no circumstances be obliged to perform duties for which the assessment has revealed a risk of exposure to lead and lead derivatives in so far as

these agents are capable of being absorbed by the human organism, which would jeopardize safety or health.

In terms of generating new data, the employer must assess the nature, degree and duration of exposure of workers to chemical agents potentially harmful for pregnant workers.

The information requirements for the operation of the Pregnant and Breastfeeding Workers Directive and any provisions for the generation of additional information are summarised in Table A1.4 in annex 1.

A1.3 Environmental Legislation

A1.2.1 Waste Framework Directive 2008/98/EC

Directive 2008/98/EC (the Waste Framework Directive) establishes a legal framework for the treatment of waste within the Community, and aims at protection of the environment and human health by way of preventing or reducing the harmful effects of waste generation and waste management. It sets a definition of hazardous waste, which are waste that fulfil certain properties (e.g. explosive, oxidizing, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic, waste which releases toxic or very toxic gases in contact with water, air or an acid, sensitizing, ecotoxic) under the Dangerous Substances Directive and the Dangerous Preparations Directive soon to be replaced by the CLP Regulation. Data generated under REACH can be used to inform whether a waste is considered or not hazardous. Section 13 of Annex II of REACH on the requirements for the compilation of safety data sheets provides that this section of the safety data sheet must describe information for proper waste management of the substance or mixture and/or its container to assist in the determination of safe and environmentally preferred waste management options, consistent with the requirements in accordance with Directive 2008/98/EC.

With regards to waste legislation, it is relevant to highlight the assumption that the volumes of 1 to 10 tonne substances channelled into waste streams will be lower than those for the high production volume substances. This can be expected to reduce the overall demand for hazard data on 1 to 10 tonne substances under the Waste Framework Directive and other waste legislation. However, the demand for data cannot be ruled out in specific instances.

Information requirements for 1 to 10 tonne substances do not cover the carcinogenicity of substances and the reproductive toxicity of substances. With regard to ecotoxicology it provides only information on aquatic toxicity and degradation. Therefore it can be considered that information for 1 to 10 tonne substances is not exhaustive enough to adequately determine whether a waste containing or made of 1 to 10 tonne substances is hazardous or not. Therefore risk management measures for hazardous waste in this specific instance (e.g. hazardous

waste must be packaged and labelled in accordance with international and Community) may not be applied.

The Waste Framework Directive aims also to distinguish between waste and non-waste by laying down the conditions to be met in order for a material to be considered a by-product and therefore not waste, and also by laying down end-of-waste conditions, for materials which were waste, but which have been through a recovery process in order to render them no longer waste. The assessment of human health impacts, physiochemical properties, and environmental impacts underlie the establishment of by-products and end-of-waste criteria as the use of the substance or object must not lead to overall adverse human health and environmental impacts, and in the case of end-of-waste criteria, should include limit values for pollutants where necessary. Information generated under REACH for 1 to 10 tonne substances may not be complete enough to support these risk assessments. For example Regulation (EU) No 333/2011[72] establishing end-of waste criteria for scrap metal provides in Annex II that the scrap may not display any hazardous properties listed in Annex III of the Waste Framework Directive defining hazardous waste.

The information requirements for the operation of the Waste Framework Directive and any provisions for the generation of additional information are summarised in Table A1.5 in Annex 1.

A1.3.2 Landfill Directive 1999/31/EC

The Landfill Directive 1999/31/EC sets requirements for the landfill of waste. The landfill requirements are not similar if waste is considered hazardous, non-hazardous or inert. Therefore as in the case of the Waste Framework Directive, information generated under REACH is useful to identify whether a waste contains substances that renders it hazardous to apply the risk management measures for the landfill of hazardous waste.

Again, the volumes of 1 to 10 tonne substances channelled into landfill will be lower than those for the high production volume substances and this can be expected to reduce the overall demand for hazard data on 1 to 10 tonne substances under the Landfill Directive.

The information requirements for the operation of the Landfill Directive and any provisions for the generation of additional information are summarised in Table A1.6.

A1.3.3 WEEE Directive 2002/96/EC

Directive 2002/96/EC on waste electrical and electronic equipment (the WEEE Directive)[73] lays down requirements for the prevention of waste electrical and

[72] Council Regulation (EU) No 333/2011 of 31 March 2011 establishing criteria determining when certain types of scrap metal cease to be waste under Directive 2008/98/EC of the European Parliament and of the Council.

[73] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), OJ L 37, 13.2.2003, p. 24.

electronic equipment (WEEE), for the reuse, recycling and other forms of recovery of such wastes so as to reduce their disposal. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment. Pursuant to Article 10(1)(d), users of electrical and electronic equipment (EEE) must provide the necessary information regarding the potential effects on the environment and human health as a result of the presence of hazardous substances in EEE. As such, the WEEE Directive draws on hazard data relating to environmental risks, as well as human health risks.

Article 3(1) of the WEE Directive defines hazardous substance as any substance which fulfils the criteria for any of the hazard classes or categories set out in Annex I of the CLP Regulation. As already mentioned above in the table on the Waste Framework Directive, information for 1 to 10 tonne substances is not exhaustive enough to adequately determine whether a substance is hazardous pursuant to Annex I of Regulation (EC) No 1272/2008. Furthermore, in the case of 1 to 10 tonne substances identified as hazardous, information will be also limited to assess their effect on the environment and human health (e.g. ecotoxicity requirements only cover aquatic toxicity and degradation). For non-Annex III 1 to 10 tonne phase in substances, no toxicity data will be available.

The information requirements for the operation of the WEEE Directive and any provisions for the generation of additional information are summarised in Table A1.7.

A1.3.4 RoHS Directive 2011/65/EU

Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (the RoHS Directive)[74] requires Member States to prevent the placing on the market of new electrical and electronic equipment (EEE) containing lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE) (note that Annex XVII of REACH sets restrictions relating to mercury, PPBs, lead compounds, and hexavalent chromium). The recast Directive entered into force on 21 July 2011 and is due to be transposed by Member States by 2 January 2013. While the recast Directive does not add any additional substances to the substance ban, the categories of EEE covered now includes medical devices and monitoring and control instruments, following transitional provisions.

The list of restricted substances in EEE under the RoHS Directive (e.g. mercury, cadmium) is subject to review and amendment. The Directive obliges the Commission, when reviewing this list to particularly take into account whether a substance including substances of very small size or with a very small internal or surface structure, or a group of similar substances:

- could have a negative impact during EEE waste management operations;

[74] Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, *OJ L 37, 13.2.2003, p. 19-23*

- could give rise, given its uses, to uncontrolled or diffuse release into the environment;
- or could give rise to hazardous residues, or transformation or degradation products through the preparation for reuse, recycling or other treatment of materials from waste EEE under current operational conditions; and
- could lead to unacceptable exposure of workers involved in the waste EEE collection or treatment processes.

As such, the recast Directive's risk assessment measures relate to design, manufacture and placing on the market of EEE, as well as the waste stage and draw on hazard data in order to assess the environmental and human health risks associated with specific substances, including risks to workers. The Commission must consider risks arising from substances in waste equipment. The review of substances listed under RoHS must use publicly available knowledge obtain from the application of REACH. Available data for 1 to 10 tonne substances may however not be adequate enough to identify all risks to the environment, human health and workers, due to limitations on toxicity data (carcinogenicity, reprotoxicity, repeat dose toxicity) and on ecotoxicity data. It is however rather theoretical (*except may be in the case of nanomaterials*) that registered substances under REACH produced between 1 to 10 tonnes may be considered as a restricted substance under the RoHS Directive.

The information requirements for the operation of the RoHS Directive and any provisions for the generation of additional information are summarised in Table A1.8.

A1.3.5 Ecolabel Regulation No 66/2010

Regulation (EC) No 66/2010[75] (the EcoLabel Regulation) lays down rules for the establishment and application of the voluntary EU Ecolabel award scheme. Products containing substances, preparations or mixtures classified as toxic, hazardous to the environment, or CMR according to CLP or substances that may be included in Annex XIV of REACH (SVHC) may not be awarded with an EU Ecolabel.

As such, hazard data will be drawn on when assessing whether granting the EU Ecolabel to products. Classification of substances as CMR under CLP will be clear, as will SVHC. Determining whether a substance is toxic or hazardous to the environment will require a review of data generated under REACH registration dossiers.

Here, available data for 1 to 10 tonne substances may suffer gaps for specific toxcitity endpoints, as well as for ecotoxicity (e. g. short-term fish toxicity, long-term toxicity in aquatic vertebrates and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances.

[75] Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel, OJ L 27, 30.1.2010, p. 1–19.

A1.3.6 Industrial Emissions Directive 2010/75/EU

Directive 2010/75/EU on industrial emissions (IED) is, by taken an integrated approach, to prevent and reduce air, water and soil pollution caused by industrial installations. Implementation of the Directive is informed by environmental hazard data, but there is no specific hazard assessment. The Directive does not draw on data on health hazards or on data on risks to the consumer.

Competent authorities when setting permits shall subject further substances to emission limit values, if they are emitted in significant quantities and bear the potential to transfer pollution from one environmental medium to another. These substances are identified at the national level by competent authorities. The Directive only provides criteria as to how these are identified. Data generated under REACH can be expected to feed into this assessment and for 1 to 10 tonne substances, ecotoxicity data is limited. For 1 to 10 tonne phase in substances not subject to the Annex III criteria, ecotoxicity data will not be available.

The Directive does not require exposure assessments or risk characterisation and hence does not generate any additional data.

A1.3.7 Water Framework Directive 2000/60/EC and the EQS Directive 2008/105/EC

The main provision of the Water Framework Directive 2000/60/EC[76] (WFD) with regard to hazardous substances is Article 16. Together with the EQS Directive[77], Article 16 of the WFD provides for the establishment of a list of priority substances, which present a significant risk to or via the aquatic environment, identified on the basis of risk assessment. The WFD foresees the establishment of Environmental Quality Standards (EQS) for priority substances, threshold levels for pollutants, the transgression of which serve to trigger risk management measures. As such, the WFD demands data specifically on the aquatic toxicity of substances.

Within the list of priority substances, priority hazardous substances, i.e. substances that are toxic, persistent and liable to bio-accumulate or which give rise to an equivalent level of concern, are to be identified. The classification of substances as priority substances and priority hazardous substances triggers specific risk management measures. Priority substances should be subject to controls for the progressive reduction of discharges, emissions and losses of the substances concerned. In the case of priority hazardous substances such controls aim at the cessation or phasing-out of discharges, emissions and losses by 2020. The first list of priority substances was adopted by Decision No 2455/2001/EC[78]. This list was replaced by the list set up in Annex II to the EQS Directive. The EQS Directive establishes limits on concentrations in surface waters (Environmental Quality Standards - EQS) for the 33 priority substances listed in its Annex II. In 2012, the

[76] Directive 2000/60/EC *(*OJ L 327, 22.12.2000, p. 1–73)

[77] Directive 2008/105/EC *(*OJ L 348 24.12.2008, p. 84–97)

[78] Decision 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC

Commission put forward a proposal (COM (2011)876) for proposal for amending the WFD and the EQS Directive in 2012 which expands this list to include an additional 15 priority substances, six of which are designated as priority hazardous substances.

The Water Framework Directive recognises that the selection of priority substances should take into account information from REACH risk assessments (during registration or substance evaluation) or use REACH methodology[79]. While most of the substances regulated under the WFD will be covered by REACH registration requirements, some such as active substances for pesticides and biocides that do not have duel uses may be exempted from REACH. In such cases, data will need to be sourced under relevant legislation (PPPR or BPD). Similarly, the EQS Directive refers to information from the registration of substances made publicly available pursuant to Article 119 of REACH as one of the sources of information on technical and scientific progress when considering revision of EQS, along with the conclusions of risk assessments used for the prioritization of substances under the Water Framework Directive, which as mentioned above is also linked to risk assessments carried out under REACH or REACH methodology.

Article 16 of the Water Framework Directive also provides for a simplified risk-based assessment procedure when necessary to meet the 4 year deadline for review of the list of priority substances. The procedure should take particular account of:

- evidence regarding the intrinsic hazard of the substance concerned, and in particular its aquatic ecotoxicity and human toxicity via aquatic exposure routes;
- evidence from monitoring of widespread environmental contamination; and
- other proven factors which may indicate the possibility of widespread environmental contamination, such as production or use volume of the substance concerned, and use patterns.

Article 16(3) of the WFD prescribes that, when selecting priority hazardous substances (i.e. those substances that shall be subject to cessation or phasing out of discharges, emissions and losses), the Commission shall take into account the selection of substances of concern undertaken in the relevant EU legislation regarding hazardous substances. This would cover, among others[80], SVHCs covered by Article 57 (d), (e) and (f) REACH, therefore also the list of substances candidate for inclusion in Annex XIV.

Data on the intrinsic hazard of the substance and on the production or use volume of the substance concerned and use patterns can be derived from information submitted within the REACH registration process and risk assessment. Regarding ecotoxicity data available under REACH registrations for 1 to 10 tonne substances, data will be available on aquatic invertebrate short-term, aquatic algal short term, and degradation

[79] Article 16(2) of the Water Framework Directive makes reference to Council Regulation (EEC) No 793/93 of 23. March 1993 on the evaluation and control of the risks of existing substances, which has been repealed by REACH. Pursuant to Article 139 REACH, references to the repealed acts shall be construed as references to REACH.

[80] Other substances would include for example substances identified under other EU legislation such as the Biocide Product Directive.

of biotic. Data will be absent on short-term fish toxicity, long-term toxicity in aquatic vertebrate and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances. Data generated for 10 to 100 tonne substances may not directly address long-term aquatic toxicity. For 1 to 10 tonne non-Annex III phase-in substances, no ecotoxicity data will be available. It should however, be noted that the WFD focuses on pollutants that are released into the environment in high volumes, hence the use of production and use data in identifying priority substances. As such, 1 to 10 tonne substances do not make up the key focus of the WFD, although it is possible that a 1 to 10 tonne substance could be found through monitoring data to be a key pollutant of European Waters due to specific release patterns.

Data on the environmental impacts of substances under various uses and likely exposure scenarios will only be available for those substances for which a **full** CSA has been conducted, i.e. greater than 10 tonne substances that are classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I or are PBT or vPvB.

Under the WFD and EQS Directive, environmental quality standards for priority substances and priority hazardous substances in surface water are set. EQS aims to control environmental risk as well as secondary poisoning and exposure of humans via the environment, as well as long-term exposure, bioaccumulation and secondary poisoning of biota. Synergies exist between the PNECs established under the REACH CSA and the EQS under the water legislation. Datasets used to generate PNECS are a valuable starting point for EQS development though it will not usually be appropriate to directly use these assessments for EQS derivation without further analysis. Important differences do exist, e.g. the need to consider field data, the need for peer review, and differences in the bioavailability assumptions underlying PNECs for metals derived in European risk assessments and the more conservative assumptions needed to fulfil the requirements of the WFD. However, it should be noted that PNECs are developed within the context of the risk assessment stage of the CSA, i.e. only for 10+ tonne substances, and in particular for those substances that are also PBT, vPvB or are classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I. As such, this data would not be available for 1 to 10 tonne substances.

In the recent draft guideline for deriving EQS it is required that possible endocrine disrupting properties should be considered in the derivation of EQS and can trigger use of a higher application factor. It is stated that 'a substance with suspected endocrine-disrupting properties might encourage an application factor that is larger than the default application factor' and further '*When substantiated evidence exists that a substance may disrupt the endocrine system of mammals, birds, aquatic or other wildlife species, the assessor should consider whether the assessment factor would be sufficient to protect against effects caused by such a mode of action, or whether an increase of the size of the application factor is needed'*.

In the ECHA guidance on information requirements and CSA, endocrine disruptors are not identified as an endpoint on their own but included e.g. in the assessment of human health repeated dose toxicity and toxicity to birds. No specific criteria or

testing strategies for endocrine disruptors are currently available and endocrine disruptor effects need be addressed on a case by case basis. No data will be available on these endpoints for 1 to 10 tonne substances.

The Water Framework Directive only considers classification of substances when identifying priority hazardous substances versus priority substances. Priority *hazardous* substances are defined as priority substances with PBT properties or which give rise to an equivalent level of concern.

Under the combined approach, the WFD uses authorisations for point and diffuse sources of pollutants as risk management measures. Data from REACH registrations will feed into the development of emission limit values in permit, and this is discuss in the section on the Industrial Emissions Directive.

Regarding additional data generation, the WFD requires the generation of monitoring data on priority substances and hazardous priority substances, as summarised in Table A1.9.

A1.4.7 Drinking Water Directive 98/83/EC

Directive 98/83/EC on the quality of water intended for human consumption[81] aims at protecting human health from the adverse effects of contamination of water intended for human consumption. The Drinking Water Directive focuses on health risk, rather than risks to the environment or the consumer.

It covers a number of chemical parameters for which parametric values are set up in Annex I. Thus, there is no hazard assessment foreseen under the Directive. Member States may also set parametric values for additional substances which, in numbers or concentrations, constitute a potential danger to human health. For 10+ tonne substances where a CSA has been conducted, the exposure assessment over the lifecycle of specific uses may be useful in the identification of possible substances present in water intended for human consumption. In addition, The DNEL values derived under the CSA for 10+ tonne substance may inform the development of values under Annex I. For 1 to 10 tonne substances, this assessment will be lacking.

A1.3.8 Groundwater Directive 2006/118/EC

The Groundwater Directive[82] is a daughter Directive to the Water Framework Directive. It sets EU-wide groundwater quality standards for nitrates and pesticides. Member States establish their own groundwater quality standards (referred to as 'threshold values'), taking into account identified risks and the list of pollutants/indicators given in Annex II of the Groundwater Directive. As such, the Groundwater Directive demands data on environmental risk, and risk to human via

[81] Directive 98/83/EC on the quality of water intended for human consumption, OJ L 330, 5.12.1998, p. 32–54

[82] Directive 2006/118/EC on the protection of groundwater against pollution and deterioration, OJ L 372, 27.12.2006, p. 19–31.

the environment. It does not specifically demand data on human health risks or risks to the consumer.

Under the Groundwater Directive, hazard data is required at two points. Firstly, Member States are responsible for identifying certain substances as being hazardous and should prevent them from entering groundwater. Hazardous substances should be understood as per the definition of the Water Framework Directive, and should include hazardous substances belonging to some of the families or groups of pollutants referred to in the indicative list of main pollutants as set by Annex VIII of the Water Framework Directive[83]. Secondly, Member States must identify pollutants and groups of pollutants, which, within their territory, have been identified as contributing to the characterisation of bodies or groups of bodies of groundwater as being at risk. For these pollutants or groups of pollutants, Member States should set up threshold values i.e. a groundwater quality standard.

When Member States establish threshold values (quality standards), they should take into account the possible impact on, and interrelationship with, associated surface waters and directly dependent terrestrial ecosystems and wetlands, as well as, inter alia, human toxicology and ecotoxicology knowledge. In deriving threshold values, they should consider the behaviour, toxicity, persistency and bioaccumulation potential of the substances. In undertaking setting threshold values, Member States will draw on the REACH registration data. For 1 to 10 tonne substances, data will be available on aquatic invertebrate short-term, aquatic algal short term, and degradation of biotic. Data will be absent on short-term fish toxicity, long-term toxicity in aquatic vertebrate and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances. Data generated for 10 to 100 tonne substances may not directly address long-term aquatic toxicity. For 1 to 10 tonne non-Annex III phase-in substances, no ecotoxicity data will be available.

When setting management measures to prevent or limit pollutant inputs into groundwater, Member States could make use of data in the CSA for 10+ tonne substances, including exposure scenarios and risk assessment, where available.

A1.4 Legislation Regulating Products – Not Exempt from REACH

The analysis undertaken in this section is limited to product legislation that involves uses not exempt from REACH.

[83] Article 6 of the Groundwater Directive requires the Member States to take account of hazardous substances belonging to the families or groups of pollutants referred to in points 1 to 6 of Annex VIII to the Water Framework Directive as well as of substances belonging to the families or groups of pollutants referred to in points 7 to 9 of that Annex, where these are considered to be hazardous. All other pollutants are substances to be limited in groundwater such that pollution does not occur.

A1.4.1 Directive 2001/95/EC on General Product Safety

The General Product Safety Directive 2001/95/EC sets in place a broad legislative framework to deal with products for consumers which are not regulated by product-specific regulation and that may pose a risk to consumers. The General Product Safety Directive establishes that Member States are to assess products that may pose a serious risk.

Registration data under REACH will be used by producers in identifying any risks which their products might pose. For 1 to 10 tonne substances that are classified as hazardous, PBT or vPvB, producers would draw on data in SDS on the hazardous properties of substances and toxicity endpoints and marry this with information on product use to assess risk. For 1 to 10 tonne phase in substances that do not meet the criteria of Annex III, no toxicity data will be available. For 10+ tonne substances where the CSA includes exposure scenarios and risk assessment, risks associated with the specific uses of the product should have been considered and particular risk management measures included.

A1.4.2 Regulation No 305/2011 for the Marketing of Construction Products

The Construction Products Regulation (EU) No 305/2011[84] requires the manufacturer to draw up a declaration of performance when placing a product on the market. This is to contain the information set out in Article 6 and includes the basic requirements set out in Annex I. Article 6(5) specifically requires REACH Title IV information is provided together with the declaration of performance, namely the SDS required under Article 31 for certain substances or mixtures[85] and the information required under Article 33 on substances in articles (in case of a SVHC present in a concentration above 0.1% by weight).

Following Article 56 and where a construction product has been found to present a risk to the basic requirements set out under Annex I of the Directive, Member States may conduct an evaluation of the product. Point 3 of Annex I deals with risks to hygiene, health and the environment, namely that:

> *"The construction works must be designed and built in such a way that they will, throughout their life cycle, not be a threat to the hygiene or health and safety of workers, occupants or neighbours, nor have an exceedingly high impact, over their entire life cycle, on the environmental quality or on the climate during their construction, use and demolition, in particular as a result of any of the following:*
> *(a) the giving-off of toxic gas;*
> *(b) the emissions of dangerous substances, volatile organic compounds (VOC), greenhouse gases or dangerous particles into indoor or outdoor air;*

84 Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonized conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88, 4.4.2011, p. 5.

85 Product areas listed in Annex IV of the Construction Products Regulation for coverage by technical standards includes mixtures, such as adhesives, coatings, and sealants, in addition to various types of articles.

(c) the emission of dangerous radiation;
(d) the release of dangerous substances into ground water, marine waters, surface waters or soil;
(e) the release of dangerous substances into drinking water or substances which have an otherwise negative impact on drinking water;
(f) faulty discharge of waste water, emission of flue gases or faulty disposal of solid or liquid waste;
(g) dampness in parts of the construction works or on surfaces within the construction works."

Data provided under REACH registrations offers a source of health and environmental information that could be used in the construction products risk assessment. For all 1 to 10 tonne substances, data will be available on physicochemical properties. To allow for the identification of dangerous substances that may pose risks to health or the environment (not defined under the Construction Products Regulation), data on specific toxicity and ecotoxicity will be required. This will be lacking for 1 to 10 tonne phase in substances not meeting the Annex III criteria. General toxicity data will be available for 1 to 10 tonne substances, with the gaps already described (respiratory irritation and sensitisation, repeat dose and specific organ toxicity, reproductive and development toxicity and carcinogenicity and toxicokinetic behaviour). Regarding data on ecotoxicity, for all other 1 to 10 tonne substances, data will be available on aquatic invertebrate short-term, aquatic algal short term, and degradation of biotic. Data will be absent on short-term fish toxicity, long-term toxicity in aquatic vertebrate and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances.

A1.4.3 Toys Directive 2009/48/EC

Directive 2009/48/EC on the safety of toys[86] lays down rules on the safety of toys and on their free movement within the internal market. The Directive contains both a general safety requirement in Article 10, as well as particular safety requirements applying to specific risks set forth in Annex II. This includes the requirements that where toys themselves are substances or mixtures, they must comply with the Dangerous Substances Directive, the Dangerous Preparations Directive and the CLP Regulation. While substances or mixtures classified as CMR may be used in toys in certain circumstances, this is on the condition that the substance or mixture is not prohibited for use in consumer articles under REACH. Appendix B of Annex II sets out the criteria to be applied in order to classify substances and mixtures, which takes account of the transitional arrangements in moving to the CLP Regulation.

Article 18 of the Toy Safety Directive requires manufacturers, before placing a toy on the market, to carry out an analysis of the chemical, physical, mechanical, electrical, flammability, hygiene and radioactivity hazards that the toy may present, as well as an assessment of the potential exposure to such hazards. Regarding any 10+ tonne

[86] Directive 2009/48/EC of the European Parliament and of the Council of 18 June 2009 on the safety of toys, OJ L 170, 30.6.2009, p.1

substances, a CSA will have been conducted and the use of a substance in toys will be covered in the CSR of any substance classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I, PBT or vPvB. This, as well as available SDS, will serve to inform the assessment. For 1 to 10 tonne substances a CSR will not be available.

While the Toys Directive relies on the classification of substances under CLP, producers or marketers of toys will draw on data provided under REACH to determine whether substances are CMR. For 1 to 10 tonne phase in substances that do not meet the criteria of Annex III, no toxicity data will be available. For all other 1 to 10 tonne substances, data will not be available on reproductive and development toxicity and carcinogenicity and toxicokinetic behaviour. In addition, the mutagenicity test information required for 1 to 10 tonne may be insufficient to determine whether a substance is mutagenic.

A1.4.4 Directive 2001/37/EC on Tobacco Products

Directive 2001/37/EC concerning the manufacture, presentation and sale of tobacco products focuses on managing the risks identified by substances contained in cigarettes. Although the Directive requires the manufacturer or the importer to submit available toxicological data on certain ingredients, the Directive does not require testing but relies on available information.

This points to a role for REACH in generating toxicology data on substances used as ingredients in tobacco products, with most of the ingredients of tobacco products (other than the actual tobacco) being subject to REACH registration. For 1 to 10 tonne phase in substances that do not meet the criteria of Annex III, no toxicity data will be available. For all other 1 to 10 tonne substances, relevant endpoints that are not included in the 1 to 10 tonne data requirements include respiratory irritation and sensitisation, repeat dose and specific organ toxicity, reproductive and development toxicity and carcinogenicity and toxicokinetic behaviour. Even for 10-100 tonne substances data will be lacking on respiratory sensitisation, carcinogenicity and toxicokinesis.

The use of the substance as an ingredient in tobacco products will be subject to a CSA if placed on the market over 10 tonnes per year. This will provide additional data on hazards, as well as exposure scenarios and risk management measures, should the substances prove to be PBT, vPvB or to be classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I.

Under the Directive, Member States may require the manufacturer or the importer to assess the potential health risks of the yield of other substances produced by their tobacco products. Where information has been made available on tobacco ingredients under a REACH CSA, this will be useful in applying such provisions.

A1.5 Legislation Regulating Products – Exempt from REACH

The analysis undertaken in this section is limited to product legislation that involves uses that are exempt from the scope of REACH. A number of uses of substances are specifically exempted from REACH, on the basis of their being subject to specific information requirements under other EU legislation. This demands an analysis of the data requirements of the legislation regulating exempted substances in order to determine whether a comparable volume and quality of data is generated. At the same time, some of these substances have other uses, i.e. duel use substances, and as such will still be subject to REACH data requirements, leading to a possible duplication of efforts.

A1.5.1 Plant Protection Products Regulation No 1107/2009 and Biocides Directive 98/8/EC

Active substances and co-formulants for use in plant protection products only are regarded as registered (Article 15(1)) and are exempted from authorisation under REACH (Article 56(4)(a)). Similarly, active substances used in biocidal products are considered registered under REACH (Article 15(2)) and are exempted from authorisation (Article 56(4)(b)). Both the Regulation (EC) No 1107/2009 concerning the placing of plant protection products on the market (PPPR) and Directive 98/8/EC concerning the placing on the market of biocidal products (BPD) set their own data requirements for applicants wanting to manufacture place on the market or use active substances safeners, synergists in biocidal products or in plant protection products. However, substances that are use both as active ingredients in pesticides and biocides as well as having other uses, i.e. duel use substances, will also be subject to REACH data requirements, leading to a possible duplication of efforts.

The information requirements under the PPPR and the BPD are, in general, comparable to the data requirements for greater than 1,000 tonne substances REACH information requirements. This is the justification as to why REACH considers active substances and co-formulants in plant protection products and active substances in biocidal products as registered, presuming that sufficient information on these substances is made available under the PPPR and the BPD. PPPR and BPD have mechanisms for risk assessment and risk management measures comparable to REACH. ECHA has to include in its database the information submitted in the framework of the BPD, which is equivalent to registration dossier data.

Regarding possible double regulation, there are some concerns relating to the scope of Article 15(1) and (2). With regards to plant protection products, co-formulants, safeners and synergists are not, or not effectively, exempted from the REACH registration obligation, even if they have already been approved/ controlled in accordance with the PPPR. For safeners and synergists, this constitutes double regulation. Co-formulants, under the current situation, are not subject to any of the legal acts enumerated in Article 15(1), and are thus *de facto* not part of the scope of Article 15(1) on exemptions. With regard to biocidal products, the current version of Article 15(2) only considers active substances as registered under REACH, while this is not the case for co-formulants. Co-formulants that are substances of concern can be

subject to a risk assessment under the BPD, and would then be covered by the BPD and the REACH assessment, which could constitute double regulation.

A1.3.2 Regulation (EC) No 1223/2009 on Cosmetic Products

The Cosmetic Regulation aims at harmonising rules, simplifying procedures and strengthening the regulatory framework regarding cosmetic products and ensuring a high level of protection of human health. A safety assessment should be carried out under the responsibility of the 'responsible person' before the cosmetic product is placed on the market and a product information file kept for each product.

The hazard assessment under the Cosmetic Products Regulation only covers two of the three elements of hazard assessment present in REACH, namely health and physicochemical hazards. With regard to health hazards, the information on toxicity should cover all relevant toxicological endpoints with a particular focus on local toxicity evaluation and skin sensitization.

The environmental impacts of cosmetics are not covered by the Cosmetic Regulation. However, since the substances used in cosmetic products are subject to REACH registration requirements, information on any environmental hazards intrinsic to these substances will become available if substances meet the thresholds for such testing. It is therefore relevant to examine whether the data requirements for 1 to 10 tonne substances provide enough data to assess the environmental impact of these substances. For 1 to 10 tonne phase-in substances that do not meet the Annex III criteria, no data will be available on ecotoxicity. For all other 1 to 10 tonne substances, information on ecotoxicity will only include data on aquatic invertebrate short-term, aquatic algal short term, and degradation of biotic. Data will be absent on short-term fish toxicity, long-term toxicity in aquatic vertebrate and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances.

A1.5.3 Food Contact Materials Regulation[87]

The core legislation controlling all food contact materials and articles is Regulation (EC) No 1935/2004. It is a horizontal measure that applies across the board to all food contact materials and articles. It aims at protecting human health and the interests of consumers from the transfer to foodstuffs of constituents of such materials and articles. Substances used in food contact materials must be authorised by EFSA before placed on the market for such use.

Regulation (EC) NO 1935/2004 sets its own data requirements that must be provided by applicants, with this data focussing on toxicological properties of the substances and not including data on ecotoxicology (risks to the environment). Based on the

[87] Regulation (EC) No 1935/2004 of the European Parliament and of the Council of 27 October 2004 on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC and 89/109/EEC.

level of exposure through migration, different toxicological information will be required. Pursuant to the an EFSA guidance[88], the core set of requirements are:

- 3 mutagenicity studies in vitro: i) A test for induction of gene mutations in bacteria ii) A test for induction of gene mutations in mammalian cells in vitro (preferably the mouse lymphoma to assay);
- a test for induction of chromosomal aberrations in mammalian cells *in vitro*;
- 90-day oral toxicity studies, normally in two species;
- studies on absorption, distribution, metabolism and excretion;
- studies on reproduction in one species, and developmental toxicity, normally in two species; and
- studies on long-term toxicity/carcinogenicity, normally in two species.

As such, the data requirements specifically for toxicology go beyond those applied to 1 to 10 tonne substances under REACH. In recognition of this and pursuant to Article 14 of REACH, the CSR for 10+ tonne substances does not need to consider risks to human health related to the use of substances in materials intended to be in contact with food.

88 EFSA guidance for petitioners presenting an application for the safety assessment of a substance to be used in food contact materials prior to its authorisation last up-date 30/07/2008, available at (http://www.efsa.europa.eu/en/efsajournal/doc/21r.pdf).

Table A1.1: Data Requirements and Generation under the Chemical Agents Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	Article 4(1) requires that the employer determine whether any hazardous chemical agents are present at the workplace and assess any risk to the safety and health of workers arising from the presence of those chemical agents. A broad set of data is required on the hazardous properties of chemical agents, as well as information on risks to the safety and health of workers. This info can be drawn from the SDS. There is no requirement for data on environmental hazards or risks, or risks to consumers		Information requirements are to inform workplace risk assessment
Available under REACH	1 to 10	1 to 10 tonne non-Annex III phase in substances: Data on physicochemical properties only. No toxicity endpoint information is provided	Key information regarding toxicity endpoints is missing. Theoretically, 1 to 10 tonne non-Annex III substances do not meet any health or environment hazard class under CLP and hence should not fall under the scope of the CAD. However, the assessment against Annex III criteria is made on the basis of available data, which may be limited
		All other substances: Information on hazardous properties will be available. For substances classified as hazardous, a SDS will be available and include hazard identification and characterisation. However, it will not include DNEL/DMEL or exposure scenarios and risk characterisation for this tonnage as a CSA will not have been performed	For all other 1 to 10 tonne substances the risk assessment may suffer from information gaps in relation to some hazard endpoints, namely: carcinogenicity; reprotoxicity; respiratory irritation and sensitisation; toxicokinetics; and repeat dose and specific organ toxicity. In addition, data on mutagenicity may be insufficient. For substances that are PBT, vPvB or classisifed under CLP a SDS will be available. Due to the lack of the CSA for >10 tonne substances, the SDS will not be able to draw on a CSR for information on exposure scenarios and risk management measures. Such information should be generated specifically for the purpose of the SDS by the registrant
	10 to 100	Information on hazardous properties will be available. For substances classified as hazardous, a SDS will be available and include hazard identification; characterisation (DNEL, DMEL); exposure scenarios and risk management measures	For hazardous 10 to 100 tonne substances there will be data gaps on carcinogencity, toxicokinetics and respiratory sensitisation.
Other	Article 4(1) requires that the employer obtain additional information which is needed for the risk assessment from the supplier or from other readily available sources. Where appropriate, this information shall comprise the specific assessment concerning the risk to users.		Employers must obtain additional information from the supplier or from other readily available sources
	Pursuant to Article 3, the Commission shall set indicative occupational exposure limit values for the protections of workers from chemical risks.		Data on DNEL or DMEL, as well as exposure scenarios and risk assessment for 10+ tonne C and M 1A and 1B substances generated under the CSA will be

Table A1.1: Data Requirements and Generation under the Chemical Agents Directive		
Requirements		**Comments**
	Article 3(6) provides that binding biological limit values may be drawn up at Community level	informed by existing OELVs at EU and MS level. REACH requires the IOELV to be taken into account when determining the DNEL (as a tool for manufacturers when doing their chemical safety assessment). The assessment undertaken by the Scientific Committee on Occupational Exposure Limits (SCOEL) used for setting the OEL on the substance should be the basis for any DNEL (inhalation), unless there are any new studies not taken into account in the assessment. IOELVs are only relevant for inhalation risks (although they can indicate that there is a dermal hazard) so oral and dermal risks need to be considered through a DNEL even if an IOELV exists. In addition, a Member State's national binding OEL (to be applied at the workplace) and the implementation of the IOELV needs to be respected even if the DNEL is higher than the IOELV. Note that there is guidance on deriving DNELs when the Community or national OEL is available in Chapter R8 of the Guidance on information requirement and the CSA
Generation of new data required?	In the case of activities involving exposure to several hazardous chemical agents, the risk shall be assessed on the basis of the risk presented by all such chemical agents in combination at relevant workstations. Data is required on the level, type and duration of exposure, the circumstances of work involving such agents, including their amount, and the circumstances of work involving such agents, including their amount	Workers' exposure at specific workstations must be measured or estimated to enable an assessment of the risks from exposure to any identified hazards. The data generated here only relates to workers' exposure to chemical agents (e.g. level, type and duration of exposure) and is not applicable more generically, to consumers or the environment. There is no requirement for the generation of additional hazard data
Classification triggers	Following Article 2(b) a hazardous chemical agent' means: (i) any chemical agent which meets the criteria for classification as a dangerous substance according to the criteria in Annex VI to Directive 67/548/EEC, whether or not that substance is classified under that Directive, other than those substances which only meet the criteria for classification as dangerous for the environment; (ii) any chemical agent which meets the criteria for classification as a dangerous preparation within the meaning of Directive 88/379/EEC, whether or not that preparation is classified under that Directive, other than those preparations which only meet the criteria for classification as dangerous for the environment; (iii) any chemical agent which, whilst not meeting the criteria for classification as dangerous in accordance with (i) and (ii), may, because of its physico-chemical,	Following Article 2(b) iii, data is required on substances that do not meet the criteria for classification as hazardous. Data requirements include the physico-chemical, chemical or toxicological properties and the way it is used or is present in the workplace. For non-Annex III phase in substances data on toxicological properties will be absent For all other 1 to 10 tonne substances, information gaps on toxicological properties relate to: carcinogenicity; reprotoxicity; respiratory irritation and sensitisation; toxicokinetics; and repeat dose and specific organ toxicity. In addition, data on mutagenicity may be insufficient.

Table A1.1: Data Requirements and Generation under the Chemical Agents Directive		
Requirements		**Comments**
	chemical or toxicological properties and the way it is used or is present in the workplace, present a risk to the safety and health of workers, including any chemical agent assigned an occupational exposure limit value under Article 3	Note that hazardous chemical agents can include substances that will not be considered under REACH such as substances generated during a certain process, e.g. wood dust
Level/type of risk assessment	Following Article 4(1) the employer determine whether any hazardous chemical agents are present at the workplace. If so, he shall then assess any risk to the safety and health of workers arising from the presence of those chemical agents. Employers must assess the risk to the safety and health of workers taking into account the information on safety and health in the SDS. Risk assessment involves 4 steps: Hazard identification. Hazard characterisation. Exposure assessment. Risk characterisation.	In conducting the risk assessment, employers will draw on the information provided in the SDS, including hazard data and relevant risk management measures (where available). In addition, the employer will generate site specific data on exposure
Demand for hazard data	Hazard data is required to allow the employer to determine whether any hazardous chemical agents are present at the workplace and to assess any risk to the safety and health of workers arising from the presence of those chemical agents. The assessment should take into consideration the following: the hazardous properties of chemical agents; and information on safety and health that shall be provided by the supplier	For 1 to 10 tonne non-Annex III phase in substances no toxicity data will be available. For all other 1 to 10 tonne substances, available data will have gaps in relation to some hazard endpoints, namely: carcinogenicity; reprotoxicity; respiratory irritation and sensitisation; toxicokinetics; and repeat dose and specific organ toxicity. In addition, data on mutagenicity may be insufficient. For substances that are hazardous, PBT, vPvB, SVHC under Annex XIV or on the Candidate List a SDS will be available and will include data on hazardous properties drawn from the relevant registration dossiers. For 10+ tonne substances that are hazardous, PBT, vPvB on the Candidate List or a SVHC the SDS will also include DNEL or DMEL. For hazardous 10 to 100 tonne substances there will be data gaps on carcinogencity, toxicokinetics and respiratory sensitisation
Demand for exposure data	Data is required on the level, type and duration of exposure to chemical agents at all relevant work stations, the circumstances of work involving	The development of risk management measures demands site specific exposure data.

Table A1.1: Data Requirements and Generation under the Chemical Agents Directive		
Requirements		**Comments**
	such agents, including their amount, and the circumstances of work involving such agents, including their amount	The employer can also be informed by data generated under the REACH CSA for 10+ tonne substances and included in the SDS. For substances that are classification as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I, PBT or vPvB, this will include exposure scenarios and risk management measures, which will serve to inform the development of on-site risk management measures. For substances that are classified for any hazard endpoint under CLP set out in Article 14(4) and Annex I, PBT, vPvB or on the Candidate List of SVHC that are manufactured and/or imported below 10 tonnes, the SDS will not include exposure scenarios or a risk assessment, meaning that the employer and worker will have less information available to develop risk management measures
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)	Workers (industrial and professional)	Not relevant for the protection of consumers or the environment

Table A1.2: Data Requirements and Generation under the Carcinogens and Mutagens Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	Demands data on hazard properties to allow for the identification of substances and preparations that are carcinogens category 1A and 1B and mutagens category 1A and 1B (formerly 1 and 2)		Information requirements are to inform workplace risk assessment
Available under REACH	1 to 10	1 to 10 tonne non-Annex III phase in substances: Data on physicochemical properties only. No toxicity endpoint information is provided.	No data will be available against which to assess C and M risks
		Information available: Mutagenicity (in vitro gene mutation study in bacteria)	No information is required for 1 to 10 tonne substances on carcinogenicity. Little information is required on mutagenicity of substances For 1 to 10 tonne substances, EU MS/ECHA may not have enough information to identify carcinogens and mutagens and to apply the adequate risk

Table A1.2: Data Requirements and Generation under the Carcinogens and Mutagens Directive			
Requirements			**Comments**
			management measures
	10 to100	Information available under REACH relevant for this Directive: Mutagenicity (in vitro gene mutation study in bacteria, in vitro cytogenicity study mammalian cells or in vitro micronucleus study, in vitro gene mutation study in mammalian cells)	No information is required for 10-100 tonne substances on carcinogenicity. More detailed information is required on mutagenicity of substances than under 1 to 10 tonne registration requirement. Information under 10-100 is unlikely to be enough to identify carcinogenic substances
Other	Under Article 16, the Council shall set out limit values in Directives on the basis of the available information, including scientific and technical data, in respect of all those carcinogens or mutagens for which this is possible, and, where necessary, other directly related provisions. Annex III of the CMD contains substances for which there are binding exposure limit values.		For non threshold substances e.g. carcinogens and mutagens, REACH requires a qualitative assessment of their risk and this could involve the generation of DMELs, which should take into account any limit values set under the CMD.
Generation of new data required?	Article 3(2) requires that the employer determine the nature, degree and duration of workers' exposure to carcinogens or mutagens in order to make it possible to assess any risk to the workers' health or safety and to lay down the measures to be taken		The data generated here only relates to workers' exposure to carcinogens or mutagens (e.g. level, type and duration of exposure) for a specific activity and is not applicable more generically, to consumers or the environment
Classification triggers	Following Article 2 (a) "carcinogen" means: i) a substance which meets the criteria for classification as a category 1 or 2 carcinogen set out in Annex VI to Directive 67/548/EEC; ii) a preparation composed of one or more substances referred to in point (i) where the concentration of one or more of the individual substances meets the requirements for concentration limits for the classification of a preparation as a category 1 or 2 carcinogen set out either: in Annex I to Directive 67/548/EEC; or in Part B of Annex II to Directive 1999/45/EC where the substance or substances do not appear in Annex I to Directive 67/548/EEC or appear in it without concentration limits; iii) a substance, preparation or process referred to in Annex I to this Directive as well as a substance or preparation released by a process referred to in that Annex; b) "mutagen" means: i) a substance which meets the criteria for classification as a category 1 or		No hazard assessment is required under the CMD, as the Directive applies only to carcinogens and mutagens that have been identified under Directive 67/548/EEC, Directive 1999/45/EC soon to be repealed by the CLP Regulation. As such, category 1A and 1B carcinogens and mutagens are listed under the CLP Regulation

Table A1.2: Data Requirements and Generation under the Carcinogens and Mutagens Directive		
Requirements		**Comments**
	2 mutagen set out in Annex VI to Directive 67/548/EEC; ii) a preparation composed of one or more substances referred to in point (i) where the concentration of one or more of the individual substances meets the requirements for concentration limits for the classification of a preparation as a category 1 or 2 mutagen set out in either: Annex I to Directive 67/548/EEC; or Part B of Annex II to Directive 1999/45/EC where the substance or substances do not appear in Annex I to Directive 67/548/EEC or appear in it without concentration limits	
Level/type of risk assessment	In the case of any activity likely to involve a risk of exposure to carcinogens or mutagens, the nature, degree and duration of workers' exposure shall be determined in order to make it possible to assess any risk to the workers' health or safety. As a priority, workers' exposure must be prevented through substitution. If not possible, the employer shall use a closed technological system. The employer shall reduce the use of a carcinogen or mutagen by replacing it with a substance not or less dangerous. Where a closed system is not technically possible, the employer shall reduce exposure to minimum through a number of risk management measures specified in the Directive. When assessing the risk, account shall be taken of all other routes of exposure, such as absorption into and/or through the skin. When the risk assessment is carried out, employers shall give particular attention to any effects concerning the health or safety of workers at particular risk and shall, *inter alia*, take account of the desirability of not employing such workers in areas where they may come into contact with carcinogens or mutagens	The risk assessment focuses on the nature, degree and duration of workers' exposure to carcinogens and mutagens. As such, it draws initially on hazard data to identify the C and M 1A and 1B substances, and then on site specific exposure data to assess risk. In cases where neither substitution nor a closed system are possible, employers should look at specific hazard data and consider all possible routes of exposure to determine which risk management measures are most appropriate
Demand for hazard data	Hazard data is required where neither substitution nor a closed system are possible and employers should look at specific hazard data and consider all possible routes of exposure to determine which risk management measures are most appropriate	Regarding the initial identification of C and M 1A and 1B, for substances already classified as C and M under CLP a SDS will be available and will include data on hazardous properties drawn from the relevant registration dossiers. Regarding the subsequent use of hazard data in developing risk management measures: for 1 to 10 tonne non-Annex III phase in substances no toxicity data will be

Table A1.2: Data Requirements and Generation under the Carcinogens and Mutagens Directive		
Requirements		**Comments**
		available; for all other 1 to 10 tonne substances, available data will have gaps in relation to carcinogenicity and toxicokinetics, while data on mutagenicity may be insufficient; and for hazardous 10 to 100 tonne substances there will be data gaps on carcinogencity and toxicokinetics. Regarding risk management, for carcinogens and mutagens that are on the market at 10+ tonne, a CSA will have been conducted and the results on hazardous properties and DNEL or DMEL included in the SDS, as well as exposure scenarios and risk management measures. This can inform decisions regarding risk management measures in those cases where it is technically impossible to avoid some level of exposure
Demand for exposure data	Employers must generate data on workers' exposure to C and M 1A and 1B at specific workstations in order to inform the risk assessment. Employers must ensure that workers' exposure shall not exceed the limit value of a carcinogen as set out in Annex III	The data required to develop risk management measures will include site specific exposure for those work stations where workers are exposed to C and M 1A and 1B data. This may be complemented by exposure scenarios and risk assessment data generated under REACH CSA for 10+ tonne substances. For 10+ tonne substances that are classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I (including carcinogens and mutagens), a CSA will have been conducted and will include exposure scenarios and risk assessment, which will serve to inform the development of on-site risk management measures. For substances that are carcinogenic or mutagenic but that are on the market at below 10 tonnes, the SDS will not include exposure scenarios or a risk assessment, meaning that the employer and worker will have less information available to develop risk management measures
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)	Workers (industrial and professional)	Not relevant for the protection of consumers or the environment

Table A1.3: Data Requirements and Generation under the Young Workers Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	The YWD takes a two-tiered approach to protecting young workers from exposure to chemical agents. Firstly, employers are obliged to assess the hazards to young people and, in that context, pay particular attention to the nature, degree and duration of exposure to chemical agents. Employers shall adopt the measures necessary to protect the safety and health of young people on the basis of a comprehensive assessment of the risks. Work involving the exposure of young people to agents which are toxic, carcinogenic, cause heritable genetic damage or harm to the unborn child or which in any other way chronically affect human health is prohibited. As such, the YWD requires data on the hazardous properties of chemical agents present at the workplace in order to determine whether work should be prohibited		Information requirements are to inform workplace risk assessment
Available under REACH	1 to 10	1 to 10 tonne non-Annex III phase in substances: Data on physicochemical properties only. No toxicity endpoint information is provided	No data will be available against which to assess relevant hazards and determine whether exposure should be prohibited
		Toxicity information available: Skin irritation/corrosion, eye irritation, skin sensitisation, mutagenicity (in vitro gene mutation study in bacteria), acute toxicity	Employers may not have enough data to prohibit young workers exposure to 1 to 10 tonne substances which are: carcinogenic, cause heritable genetic damage, or harm to the unborn child or which in any other way chronically affect human health. Indeed, no information is required for 1 to 10 tonne substances on carcinogenicity, repeat dose and specific organ toxicity, reproductive and developmental toxicity or toxicokinesis. Respiratory irritation and sensitisation is also not covered
	10 to100	Toxicity information available: Skin irritation/corrosion, eye irritation, skin sensitisation, mutagenicity (in vitro gene mutation study in bacteria), acute toxicity, repeat dose toxicity, reproductive toxicity and toxicokinesis	For 10-100 tonne substances information is not required on carcinogenicity of substances. Employers may not have enough information on 10-100 tonne substances to identify carcinogenic substances
Generation of new data required?	Article 6 (2)(b) requires that the employer assess the risks to young people, involving generating data on the nature, degree and duration of exposure to physical, biological and chemical agents		The data generated here only relates to the on-site workers' exposure to chemical agents (e.g. level, type and duration of exposure) and is not applicable more generically, to consumers or the environment
Classification triggers	Classification of chemical agents in the workplace as hazardous triggers a prohibition on young people working there. Article 7(2) requires that Member States prohibit the employment of		For 1 to 10 tonne substances, the available data does not cover all relevant endpoints, with those excluded specified above. The result is that employers may not identify substances that should trigger a

Table A1.3: Data Requirements and Generation under the Young Workers Directive		
Requirements		**Comments**
	young people for: work involving harmful exposure to agents which are toxic, carcinogenic, cause heritable genetic damage, or harm to the unborn child or which in any other way chronically affect human health; work involving harmful exposure to the following chemical agents: (Annex I, point I) Substances and preparations classified according to Council Directive 67/548/EEC and Council Directive 88/379/EEC to the classification, packaging and labelling of dangerous preparations (3) as toxic (T), very toxic (Tx), corrosive (C) or explosive (E); (b) Substances and preparations classified according to Directives 67/548/EEC and 88/379/EEC as harmful (Xn) and with one or more of the following risk phrases: danger of very serious irreversible effects (R39),possible risk of irreversible effects (R40), may cause sensitization by inhalation (R42), may cause sensitization by skin contact (R43), may cause cancer (R45), may cause heritable genetic damage (R46), danger of serious damage to health by prolonged exposure (R48), may impair fertility (R60), may cause harm to the unborn child (R61); (c) Substances and preparations classified according to Directives 67/548/EEC and 88/379/EEC as irritant (Xi) and with one or more of the following risk phrases: highly flammable (R12); may cause sensitization by inhalation (R42), may cause sensitization by skin contact (R43), (d) Substances and preparations referred to Article 2 (c) of Council Directive 90/394/EEC of 28 June 1990 on the protection of workers from the risks related to exposure to carcinogens at work (e) Lead and compounds thereof, inasmuch as the agents in question are absorbable by the human organism	prohibition of work, resulting in the exposure of young people to these substances in the workplace
Level/type of risk assessment	Following Article 6 (2)(b), an assessment of risks must be made before young people begin work and when there is any major change in working conditions and must pay particular attention to the nature, degree and duration of exposure to physical, biological and chemical agents. In addition, the risk assessment should consider the form, range and use of work equipment and the arrangement of work processes and operations	The assessment demands data on the hazard properties of the chemical agents present in the workplace, to be found in the SDS, as well as site specific exposure data. The exposure scenarios included in the SDS for 10+ tonnes substances will not be relevant since working with substances that are hazardous, PBTs or vPvB will be prohibited under Article 7
Demand for hazard data	Hazard data is required to inform the identification of chemical agents that may be present in the workplace and to which young people may be	In conducting their risk assessment, employers will refer to the SDS for specific chemical agents in order to determine what their hazard properties are. As

Table A1.3: Data Requirements and Generation under the Young Workers Directive		
Requirements		**Comments**
	exposed. In particular, hazard data should allow for the identification of agents that are toxic, carcinogenic, cause heritable genetic damage, or harm to the unborn child or which in any other way chronically affect human health, as well as chemical agents referred to in point I of the Annex. The presence of these substances in the workplace then serves to trigger a prohibition of work	discussed above, the SDS for 1 to 10 tonne substances may not include relevant hazard data to allow for this assessment
Demand for exposure data	The YWD demands on site exposure data	
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)	Young Industrial and professional workers	Not relevant for consumers and/or the environment

Table A1.4: Data Requirements and Generation under the Pregnant and Breastfeeding Workers Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	In principle, employers should draw on hazard data in the SDS to identify substances that meet the criteria for the following r-phrases: R40: Limited evidence of a carcinogenic effect R45: May cause cancer R46: May cause heritable genetic damage R 47: May cause birth defects – now deleted and replaced by: R60: May impair fertility R61: May cause harm to the unborn child R62: Possible risk of impaired fertility R63: Possible risk of harm to the unborn child R64: May cause harm to breastfed babies The employer must conduct a risk assessment to the nature, degree and duration of exposure to certain types of chemical agents in so far as it is known that they endanger the health of pregnant women and the unborn child (non-exhaustive list in Annex I point 3 of the Directive)		Information requirements are to inform workplace risk assessment.
Available under REACH	1 to 10	Relevant information available on: mutagenicity (in vitro gene mutation study in bacteria)	No data available on: carcinogenicity of substances; repeated dose toxicity; reproductive toxicity

Table A1.4: Data Requirements and Generation under the Pregnant and Breastfeeding Workers Directive			
Requirements			**Comments**
	10 to 100	Relevant information available on: muta. (including in vitro gene mutation study in bacteria, in vitro cytogenicity study mammalian cells or in vitro micronucleus study, in vitro gene mutation study in mammalian cells) (point 8(4)), repro. toxicity	No data available on: carcinogenicity
Other			No other sources of information mentioned in the legislation
Generation of new data required?	Article 4(1) read in conjunction with Annex I point 3 states that the employer shall assess the nature, degree and duration of exposure, in the undertaking and/or establishment concerned, of pregnant workers, workers who have recently given birth, workers who are breastfeeding to certain types of chemical agents.		The data generated here only relates to workers' exposure to certain chemical agents (e.g. level, type and duration of exposure) and is not applicable more generically, to consumers or the environment.
Classification triggers	Following Article 4(1) read in conjunction with Annex I point 3, a risk assessment is required when pregnant workers are exposed to following chemical agents, in so far as it is known that they endanger the health of pregnant women and the unborn child: (a) substances labelled R 40, R 45, R 46, and R 47 under Directive 67/548/EEC (2) in so far as they do not yet appear in Annex II; (b) chemical agents in Annex I to Directive 90/394/EEC (3); (carcinogens and mutagens) (c) mercury and mercury derivatives; (d) antimitotic drugs; (e) carbon monoxide; (f) chemical agents of known and dangerous percutaneous absorption. In order to assess any risks to the safety or health and any possible effect on the pregnancy or breastfeeding of workers		As mentioned above, for 1 to 10 tonne substances REACH does not require information on: carcinogenicity of substances; repeated dose toxicity; reproductive toxicity. This implies that employers may not be able to identify whether 1 to 10 tonne substances fall under these categories and may not conduct the risk assessment required under this Directive
Level/type of risk assessment	The employer shall assess the nature, degree and duration of exposure, in the undertaking and/or establishment concerned, of pregnant workers, workers who have recently given birth, workers who are breastfeeding to Annex I chemical agents in so far as it is known that they endanger the health of pregnant women and the unborn child		In conducting their risk assessment, employers will refer to the SDS for specific chemical agents in order to determine what their hazard properties are. SDS for 1 to 10 tonne substances may not include relevant hazard data for specific R-Phrases. Data limitations are discussed above. For substances that are classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I and that endanger the health of pregnant women and the unborn child but that are on the market at below 10 tonnes, the SDS will not include exposure scenarios or a risk assessment, meaning that the employer and worker will have less information available to develop risk management measures

Table A1.4: Data Requirements and Generation under the Pregnant and Breastfeeding Workers Directive		
Requirements		**Comments**
Demand for hazard data	Demands hazard data to identify substances that can be grouped under the R-Phrases R40, R45, R46, R60-64	The lack of information requirements on carcinogenicity, reproductive toxicity for 1 to 10 tonne substances may mean that employers are unable to determine whether substances fall under these R-Phrases
Demand for exposure data	The employer shall assess the nature, degree and duration of exposure, in the undertaking and/or establishment concerned, of pregnant workers, workers who have recently given birth, workers who are breastfeeding to certain types of chemical agents	The Pregnant Workers Directive demands on site exposure data.
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)	Young Industrial and professional pregnant breast-feeding and workers	Not relevant for consumers and or the environment

Table A1.5: Data Requirements and Generation under the Waste Framework Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	The Waste Framework Directive provides a definition of hazardous waste and sets specific measures		Information requirements are to inform whether a waste is considered hazardous or not. Information requirements under REACH can be used in the by-product and end-of-waste risk assessment
Available under REACH	1 to 10	Relevant data available for the definition of hazardous waste and for the risk assessment of by-products and end-of waste criteria Physicochemical properties (including flammability, flash-point, explosive properties, oxidising properties) Toxicology (Skin irritation /skin corrosion, Eye irritation, Skin sensitisation, Mutagenicity) Ecotoxicology (aquatic toxicity, degradation)	Wastes are considered hazardous if they have certain properties (e.g. explosive, oxidizing, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic, waste which releases toxic or very toxic gases in contact with water, air or an acid, sensitizing, ecotoxic) Information requirements for 1 to 10 tonne substances do not cover the carcinogenicity of substances or the reproductive toxicity of substances and it requires only limited data on mutagenicity. With regard to ecotoxicology it provides only information on aquatic toxicity and degradation. Therefore it can be considered that information for 1 to 10 tonne substances is not exhaustive enough to adequately determine whether a waste containing or made of 1 to 10 tonne substances is hazardous or not. Information for the risk-assessment for end-of waste criteria and by-products may also be lacking

Table A1.5: Data Requirements and Generation under the Waste Framework Directive			
Requirements			**Comments**
	10 to100	Relevant data available for the definition of hazardous waste: Physicochemical properties (including flammability, flash-point, explosive properties, oxidising properties) Toxicology (Skin irritation /skin corrosion, Eye irritation, Skin sensitisation, Mutagenicity, repeated dose toxicity, reproductive toxicity) Ecotoxicology (aquatic toxicity, degradation, fate and behaviour in the environment)	Information requirements for 10-100 tonne substances do not cover the carcinogenicity of substances. This is one of the properties of waste to take into account for the classification of hazardous waste.
Other			Not relevant
Generation of new data required?			No generation of data required under the Waste Framework Directive
Classification triggers	Properties of waste which render it hazardous: Explosive': substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene. H 2 'Oxidizing': substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances. H 3-A 'Highly flammable' — liquid substances and preparations having a flash point below 21 °C (including extremely flammable liquids),or — substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy, or — solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition, or — gaseous substances and preparations which are flammable in air at normal pressure, or — substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities. H 3-B 'Flammable': liquid substances and preparations having a flash point equal to or greater than 21 °C and less than or equal to 55 °C.		The categorisation of a waste as hazardous waste under the Framework Directive on Waste is important as it then triggers a number of additional requirements regarding the management of hazardous wastes: Article 17: ensuring that the production, collection, transportation, storage and treatment are carried out in conditions that provide protection for the environment and human health, including traceability. Article 18: Hazardous waste shall not be mixed with other categories of hazardous waste, waste substances or materials, unless the mixing in carried out by an establishment or undertaking with a permit, adverse effect on the environment is not increased and best available techniques are employed. Article 19: In the course of collection, transport and temporary storage, hazardous waste must be packaged and labelled in accordance with international and Community standards in force. Hazardous waste that is transferred within a Member State shall be accompanied by an identification document. Article 35: Establishments or undertakings producing, collecting, transporting or dealing in hazardous wastes shall keep records of the quantity, nature and origin of the waste, and where relevant of the destination, frequency of collection, mode of transport and treatment methods foreseen. Records for hazardous waste are to be preserved for at least three months, with a minimum duration of 12 months. The information shall be made available to the competent authorities upon request

Table A1.5: Data Requirements and Generation under the Waste Framework Directive		
Requirements		**Comments**
	H 4 'Irritant': non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation. H 5 'Harmful': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks. H 6 'Toxic': substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death. H 7 'Carcinogenic': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence H 8 'Corrosive': substances and preparations which may destroy living tissue on contact. H 9 'Infectious': substances and preparations containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms. H 10 'Toxic for reproduction': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce non-hereditary congenital malformations or increase their incidence. H 11 'Mutagenic': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects or increase their incidence. H 12 Waste which releases toxic or very toxic gases in contact with water, air or an acid. H 13 (*) 'Sensitizing': substances and preparations which, if they are inhaled or if they penetrate the skin, are capable of eliciting a reaction of hypersensitization such that on further exposure to the substance or preparation, characteristic adverse effects are produced. H 14 'Ecotoxic': waste which presents or may present immediate or delayed risks for one or more sectors of the environment.	
Level/type of risk assessment	The application of the end-of-waste and by-products criteria require the assessment of their human health impacts, physiochemical properties, and environmental impacts	Information generated under REACH 1 to 10 tonne substances may not be sufficient to adequately identify the health and environmental impact of these products
Demand for	See row on classification trigger for the definition of hazardous waste.	The determination of hazardous waste demands data on the waste properties

Table A1.5: Data Requirements and Generation under the Waste Framework Directive			
Requirements			**Comments**
hazard data			(e.g. explosive, oxidizing, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic, waste which releases toxic or very toxic gases in contact with water, air or an acid, sensitizing, ecotoxic). As already mentioned above the information requirement for 1 to 10 tonne substances may not be sufficient to adequately categorise waste as hazardous waste under the Waste Framework Directive Demand for hazard data from REACH may also be relevant for the risk assessments to be applied for end-of-waste and by-product criteria
Demand for exposure data			Not relevant
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)			Environment, human health in general

Table A1.6: Data Requirements and Generation under the Landfill Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	The landfill Directive sets requirements for the landfill of waste. The measures are not similar in case of landfill for hazardous waste, landfill for non-hazardous waste, landfill for inert waste. This Directive refers to the Waste Framework Directive for the definition of hazardous waste. Demand for information will thus be on the substances in waste that renders it hazardous		Information requirements are to inform whether a waste is considered hazardous or not
Available under REACH	1 to 10	Relevant data available for the definition of hazardous waste: Physicochemical properties (including flammability, flash-point, explosive properties, oxidising properties) Toxicology (Skin irritation /skin corrosion, Eye irritation, Skin sensitisation, Mutagenicity)	See table above on the Waste Framework Directive

Table A1.6: Data Requirements and Generation under the Landfill Directive			
Requirements			**Comments**
		Ecotoxicology (aquatic toxicity, degradation)	
	10 to 100	Relevant data available for the definition of hazardous waste: Physicochemical properties (including flammability, flash-point, explosive properties, oxidising properties). Toxicology (Skin irritation /skin corrosion, Eye irritation, Skin sensitisation, Mutagenicity, repeated dose toxicity, reproductive toxicity). Ecotoxicology (aquatic toxicity, degradation, fate and behaviour in the environment)	Idem
Other			Not relevant
Generation of new data required?			
Classification triggers	Article 4 The Directive establishes three classes of landfill on the basis of the types of waste that they will receive, namely: □ Landfill for hazardous waste □ Landfill for non-hazardous waste □ Landfill for inert waste Article 5(3)(b) Member States shall take measures in order that the following wastes are not accepted in a landfill: […] (b) waste which, in the conditions of landfill, is explosive, corrosive, oxidising, highly flammable or flammable, as defined in Annex III to Directive 91/689/EEC		The technical requirements in terms of monitoring waste inputs, controlling emissions and monitoring leachates differ from the different landfills, with requirements being most stringent for landfill for hazardous waste and least stringent for landfill for inert waste. It is therefore relevant that information for 1 to 10 tonne substances under REACH is adequate enough to help determine when a waste is considered hazardous
Level/type of risk assessment			No risk assessment required
Demand for hazard data	Article 5(3)(b) Member States shall take measures in order that the following wastes are not accepted in a landfill: […] (b) waste which, in the conditions of landfill, is explosive, corrosive, oxidising, highly flammable or flammable, as defined in Annex III to Directive 91/689/EEC. Article 6(b): only hazardous waste that fulfils the criteria set out in accordance with Annex II is assigned to a hazardous		Information on whether a waste is explosive, corrosive, oxidising, highly flammable or flammable is required to identify whether waste must be accepted or not in landfills. These data should be covered by Annex VII of REACH. Article 6(b) requires data on the ecotoxicological properties of hazardous waste to identify whether hazardous waste fulfils the criteria to be assigned to a hazardous landfill. However, REACH 1 to 10 tonne substances requirement provide limited information on ecotoxicological properties of substances

Table A1.6: Data Requirements and Generation under the Landfill Directive		
Requirements		**Comments**
	landfill; (e.g. requirements on knowledge of total composition, limitations on the amount of organic matter in the waste, requirements or limitations on the biodegradability of the organic waste components, limitations on the amount of specified, potentially harmful/hazardous components (in relation to the abovementioned protection criteria), limitations on the potential and expected leachability of specified, potentially harmful/hazardous components (in relation to the abovementioned protection criteria), ecotoxicological properties of the waste and the resulting leachate	
Demand for exposure data		Not relevant
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)		Protection of the environment and public health in general

Table A1.7: Data Requirements and Generation under the WEEE Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	Article 10(1)(d) of the Directive requires that users of EEE in private households are given the necessary information regarding the potential effects on the environment and human health as a result of the presence of hazardous substances in EEE		Information requirements are to inform whether a substance in EEE is hazardous or not and their potential effect on the environment and human health
Available under REACH	1 to 10	All data available under REACH 1 to 10 tonne substances information requirements are relevant for determining hazardous substances in EEE and their potential environment and human health effect	The WEE Directive defines hazardous substance as any substance which fulfils the criteria for any of the hazard classes or categories set out in Annex I of the CLP Regulation Information requirements for 1 to 10 tonne substances do not cover the: carcinogenicity of substances; repeated dose toxicity; and reproductive toxicity of substances.

Table A1.7: Data Requirements and Generation under the WEEE Directive			
Requirements			**Comments**
			It requires limited data on mutagenicity. With regard to ecotoxicology it provides only information on aquatic toxicity and degradation Therefore it can be considered that information for 1 to 10 tonne substances is not exhaustive enough to adequately determine whether a substance is hazardous pursuant to Regulation (EC) No 1272/2008. Furthermore when 1 to 10 tonne substances are identified as hazardous it is unlikely that the information requirements under Annex VII of REACH cover all their potential impact on human health and the environment.
	10 to 100	All data available under REACH 10 to 100 tonne substances information requirements are relevant for determining hazardous substances in EEE	The WEE Directive defines hazardous substance as any substance which fulfils the criteria for any of the hazard classes or categories set out in Annex I of the CLP Regulation Information requirements for 10-100 tonne substances do not cover the: carcinogenicity of substances; and carcinogens are however considered hazardous substances pursuant to Annex I of Regulation (EC) No 1272/2008
Other			
Generation of new data required?			No generation of data required
Classification triggers	Article 3(l) of the WEEE Directive defines dangerous substances or mixtures as any mixture considered dangerous under Directive 1999/45/EC relating to the classification, packaging and labelling of dangerous preparations124 (to be replaced by the CLP Regulation in 2015), or any substance which fulfils the criteria for any of the hazard classes or categories set out in Annex I of the CLP Regulation		Users of EEE in private households must be given the necessary information regarding the potential effects on the environment and human health as a result of the presence of hazardous substances in EEE. Therefore the identification of hazardous substances in EEE triggers the obligation to provide information to users in EEE on their potential effects on human health and the environment. As already mentioned in the Table below information on 1 to 10 tonne substances may not be sufficient to adequately determine whether a substance is hazardous pursuant to Annex I of the CLP Regulation
Level/type of risk assessment			No risk assessment required
Demand for hazard data	Article 10(1)(d) of the Directive requires that users of EEE in private households are given the necessary information regarding the potential		Demand for hazard data is required to provide necessary information to users on the potential health and environment effects of hazardous substances in EEE.

Table A1.7: Data Requirements and Generation under the WEEE Directive			
Requirements			**Comments**
	effects on the environment and human health as a result of the presence of hazardous substances in EEE		The data generated for 1 to 10 tonne substances may not be sufficient to fulfil this obligation
Demand for exposure data			No demand for exposure data
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)			consumers, workers and the environment

Table A1.8: Data Requirements and Generation under the RoHS Directive			
Requirements			**Comments**
Use of information (+specific endpoints) Demand for information	The RoHS Directive provides a review procedure to amend the list of restricted substances in electrical and electronic equipment. When reviewing this list, the Commission must particularly take into account whether a substance could have a negative impact during EEE waste management operations, could give rise, given its uses, to uncontrolled or diffuse release into the environment, or could give rise to hazardous residues, or transformation or degradation products through the preparation for reuse, recycling or other treatment of materials from waste EEE under current operational conditions; could lead to unacceptable exposure of workers involved in the waste EEE collection or treatment processes		Information requirements are to inform the Commission during the review and amendment of the list of restricted substances in EEE.
Available under REACH	1 to 10	Information relevant for assessing negative impact during EEE waste management operations: Vapour pressure, flashpoint, flammability, explosive properties, self-ignition temperature, oxidising properties, granulometry Information relevant for the impact for diffuse release into the environment Ecotoxicity (Aquatic invertebrate - short-term aquatic algal short-term, degradation –biotic) (except phase-in substance not meeting Annex III Criteria)	REACH 1 to 10 tonne substances requirements should be exhaustive enough to identify information relevant for assessing negative impact during EEE waste management operations. With regard to the identification of the impact of substance for diffuse release into the environment, 1 to 10 tonne substances requirement provide very limited information on ecotoxicity that does not cover for example bioconcentration and bioaccumulation requirements. 1 to 10 tonne substances requirement does not provide information on carcinogenicity, toxicokinetics, reproductive toxicity which might be however

Table A1.8: Data Requirements and Generation under the RoHS Directive			
Requirements			**Comments**
		Information to identify substances having unacceptable impact on workers exposed Vapour pressure, flashpoint, flammability, explosive properties, self-ignition temperature, oxidising properties, granulometry, skin irritation/corrosion (except phase-in substance not meeting Annex III Criteria), eye Irritation (except phase-in substance not meeting Annex III Criteria), skin sensitisation (except phase-in substance not meeting Annex III Criteria), Mutagenicity – prokaryote (except phase-in substance not meeting Annex III Criteria)	relevant for the identification of substances with unacceptable impact on workers
	10 to 100	Information relevant for assessing negative impact during EEE waste management operations Vapour pressure, flashpoint, flammability, explosive properties, self-ignition temperature, oxidising properties, granulometry, adsorption/ desorption Information relevant for the impact for diffuse release into the environment Ecotoxicity (Aquatic invertebrate - short-term aquatic algal short-term, degradation –biotic, Degradation – abiotic, Aquatic fish – short term, STP – Microorganisms) Information to identify substances having unacceptable impact on workers exposed Vapour pressure, flashpoint, flammability, explosive properties, self-ignition temperature, oxidising properties, granulometry, skin irritation/corrosion, eye Irritation, skin sensitisation, mutagenicity – prokaryote and eukaryote, repeated dose toxicity, reproductive toxicity, specific organ toxicity, developmental toxicity	REACH 10-100 tonne substances requirements should provide enough information to identify information relevant for assessing negative impact during EEE waste management operations. With regard to the identification of the impact of substances for diffuse release into the environment, 10-100 tonne substances requirement provide very limited information on ecotoxicity that does not cover for example bio concentration and bioaccumulation. 10-100 tonne substances requirement does not provide information on carcinogenicity, which is however relevant for the identification of substances with unacceptable impact on workers
Other			The proposals for review of the restricted substances must provide information on references and scientific evidence for the restrictions.
Generation of new data required?	Article 6(2) The proposals to review and amend the list of restricted substances, or a group of similar substances must contain information on references and scientific evidence for the restriction, on the use of the substance or the group of similar substances in EEE, on detrimental effects and exposure in particular during waste EEE management operations.		The Directive does not explicitly mention the obligation to generate new data under the review procedure. However pursuant to Article 6(2), the proposals to review and amend the list of restricted substances must contain among others references and scientific evidence for the restriction, information on detrimental effects and exposure in particular during EEE waste management operation

Table A1.8: Data Requirements and Generation under the RoHS Directive		
Requirements		**Comments**
Classification triggers		No classification triggers here
Level/type of risk assessment	Article 6 provides that the review and the amendment of the list of restricted substances must be based on a thorough assessment that must take special account of whether a substance, including substances of very small size or with a very small internal or surface structure, or a group of similar substances: could have a negative impact during EEE waste management operations, including on the possibilities for preparing for the reuse of waste EEE or for recycling of materials from waste EEE; could give rise, given its uses, to uncontrolled or diffuse release into the environment of the substance, or could give rise to hazardous residues, or transformation or degradation products through the preparation for reuse, recycling or other treatment of materials from waste EEE under current operational conditions; and could lead to unacceptable exposure of workers involved in the waste EEE collection or treatment processes	The risk assessment would cover the: the negative impact of substances during waste management operations; The impact of release of substances into the environment; and The impact on worker involved in the WEEE industry. As mentioned above it is unlikely that 1 to 10 substances information requirement will be sufficient enough to adequately cover this assessment
Demand for hazard data		As mentioned above the review procedure will use date generated under REACH. It is unlikely that 1 to 10 tonne substances requirements may be sufficient to fulfil this data request
Demand for exposure data		No demand for exposure data required
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)		Workers in the waste industry, the environment and human health in general

Table A1.9: Data Requirements and Generation under the Water Framework Directive and EQS Directive		
Requirements		**Comments**
Use of	The WFD requires the identification of priority substances which present a	

Table A1.9: Data Requirements and Generation under the Water Framework Directive and EQS Directive			
Requirements			**Comments**
information (+specific endpoints) Demand for information	significant risk to or via the aquatic environment, identified on the basis of risk assessment. Within the list of priority substances, priority hazardous substances, i.e. substances that are toxic, persistent and liable to bio-accumulate or which give rise to an equivalent level of concern, are to be identified. Environmental Quality Standards (EQS) are to be established for priority substances and priority hazardous substances, threshold levels for pollutants, the transgression of which serve to trigger risk management measures. As such, the WFD demands data specifically on the aquatic toxicity of substances		
Available under REACH	1 to 10	Data will be available on aquatic invertebrate short-term, aquatic algal short term, and degradation of biotic	Data will be absent on short-term fish toxicity, long-term toxicity in aquatic vertebrate and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances. For 1 to 10 tonne non-Annex III phase-in substances, no ecotoxicity data will be available
	10 to 100	Data will be available on aquatic invertebrate short-term, aquatic algal short term, degradation of biotic, short-term fish toxicity and the bioaccumulation and bioconcentration potentials of the substances	Data generated for 10 to 100 tonne substances may not directly address long-term aquatic toxicity
Other	Possible endocrine disrupting properties should be considered in the derivation of EQS and can trigger use of a higher application factor		No specific criteria or testing strategies for endocrine disruptors are currently available and endocrine disruptor effects need be addressed on a case by case basis. No data will be available on these endpoints for 1 to 10 tonne substances
Generation of new data required?	The extensive EU wide monitoring programme of the WFD will generate new data on the environmental exposure of priority substances		
Classification triggers	The WFD only considers the classification of substances when identifying priority hazardous substances versus priority substances. Priority *hazardous* substances are defined as priority substances with PBT properties or which give rise to an equivalent level of concern		
Level/type of risk assessment	The risk assessment draw on data generated under REACH on the hazardous properties of substances and marries this with exposure data generated through an extensive EU wide monitoring programme in order to identify priority hazardous substances. Data on use patterns and product volumes for		PNECs will only be available for 10+ tonne substances that are also PBT, vPvB or classified as hazardous under CLP, i.e. for which a full CSA has been conducted. PNECs would not be available for 1 to 10 tonne substances

Table A1.9: Data Requirements and Generation under the Water Framework Directive and EQS Directive		
Requirements		**Comments**
	specific substances may also be used to identify priority substances. The establishment of EQS, threshold values, may draw on the PNECs developed in the context of a REACH CSA	
Demand for hazard data	The selection of priority substances should take into account information from REACH risk assessments or use REACH methodology. The assessment demands data on the intrinsic hazard of the substance concerned, and in particular its aquatic ecotoxicity and human toxicity via aquatic exposure routes. Similarly, the EQS Directive refers to information from the registration of substances made publicly available pursuant to Article 119 of REACH as one of the sources of information on technical and scientific progress when considering revision of EQS, along with the conclusions of risk assessments used for the prioritization of substances under the Water Framework Directive, which as mentioned above is also linked to risk assessments carried out under REACH or REACH methodology	For 1 to 10 tonne substances, data will be available on aquatic invertebrate short-term, aquatic algal short term, and degradation of biotic. Data will be absent on short-term fish toxicity, long-term toxicity in aquatic vertebrate and invertebrate species and the bioaccumulation and bioconcentration potentials of the substances. Data generated for 10-100 tonne substances may not directly address long-term aquatic toxicity. For 1 to 10 tonne non-Annex III phase-in substances, no ecotoxicity data will be available. Some such as active substances for pesticides and biocides that do not have duel uses may be exempted from REACH. In such cases, data will need to be sourced under relevant legislation (PPPR or BPD)
Demand for exposure data	Extensive monitoring programmes for priority substances and hazardous priority substances are foreseen under the WFD. In identifying priority substances, the risk assessment should also take into account other proven factors which may indicate the possibility of widespread environmental contamination, such as production or use volume of the substance concerned, and use patterns. Production volume may be drawn from an overview of the REACH registration dossiers	Data on specific use patterns will not be available for 1 to 10 tonne substances. Data on the environmental impacts of substances under various uses and likely exposure scenarios will only be available for those substances for which a full CSA has been conducted, i.e. 10+tonne substances that are classified as hazardous for any hazard endpoint under CLP set out in Article 14(4) and Annex I or are PBT or vPvB
Protected (Industrial Workers, Professional Workers, Consumers and/or Environment)		Environment, human health risks via the environment (drinking water)