JOINT RESEARCH CENTRE
Institute for Prospective Technological Studies (IPTS)

Revision of European Ecolabel Criteria for Hand Dishwashing Detergents

PRELIMINARY REPORT

for

THE REVISION OF ECOLOGICAL CRITERIA FOR HAND DISHWASHING DETERGENTS

1) Introduction
2) Scope and definition
3) Market analysis
4) Technical/Environmental analysis
5) Product innovations and improvement potential

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Development of European Ecolabel Criteria for Hand Dishwashing Detergents

Preliminary Report

Working Document

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ABBREVIATIONS AND ACRONYMS

AISE	International Association for Soaps, Detergents and Maintenance Products
AE	ethoxylated alcohol
aNBO	aerobically non-biodegradable
anNBO	anaerobically non-biodegradable
APD	alkyl phenol derivative
APEO	alkylphenol ethoxylate
ASP	Advanced Sustainability Profile
BCF	bioconcentration factor
BPD	Biocidal Products Directive (98/8/EC)
BPR	BIocidal Products Regulation, Regulation (EU) 528/2012)
BRIC	Brazil, Russia, India and China
CADD	consumer automatic dishwasher detergents
CAGR	compound annual growth rate
CDV	critical dilution volume
CFC	chlorofluorocarbon
CLP	(EU Regulation on the) Classification, Labelling and Packaging of Substances and Mixtures
COMEXT	statistical database on trade of goods managed by Eurostat
DADMAC	diallyldimethylammonium chloride
DD	dishwasher detergents
DID list	Detergents Ingredient Database
DTPA	diethylene triamine pentaacetic acid
EC	European Commission
EC50	median effective concentration
ECHA	European Chemicals Agency
EDTA	ethylenediaminetetraacetic acid
EEA	European Economic Area
EU	European Union
GDP	gross domestic product
GHG	greenhouse gas
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
GLDA	glutamic acid diacetic acid
GPP	Green Public Procurement
I&I	industrial and institutional
IC50	median inhibition concentration
IIDD	industrial and institutional dishwasher detergents
IFRA	International Fragrance Association
IKW	Industrieverband Körperpflege- und Waschmittel e. V.
ISO	International Organisation for Standards
K_{OW}	octanol-water partition coefficient
LAS	linear alkylbenzene sulphonate
LCA	life cycle assessment
LCIA	life cycle impact assessment
LC50	median lethal dose
LHC	Liquid household cleaner
MGDA	methylglycinediacetic acid
NACE	Nomenclature des Activités Économiques dans la Communauté Européenne

n.e.c.	not elsewhere classified
NLT	natural land transformation
n.p.r.s	not packaged for retail sale
NTA	nitrilotriacetic acid
PBT	persistent, bio-accumulable and toxic
PET	polyethylene terephthalate
ppm	parts per million
PRODCOM	PRODuction COMmunautaire (Community Production)
p.r.s	Packaged for retail sale
PVC	polyvinyl chloride
REACH	Registration, Evaluation, Authorisation and restriction of CHemicals
SVHC	substances of very high concern
TAED	tetraacetylethylenediamine
vPvB	very persistent and very bio-accumulable
WUR	weight/utility ratio

TERMS AND DEFINITIONS

Domestic hand dishwashing detergents	In this report, denotes hand dishwashing detergent products which are intended for use principally in households.
Professional, institutional or industrial hand dishwashing detergent	In this report, denotes hand dishwashing detergent products with are intended for use solely by professional users in the industrial and institutional sector. 'Industrial and institutional detergent' means a detergent for washing and cleaning outside the domestic sphere, carried out by specialised personnel using specific products.
Cleaning	According to EN ISO 862 Surface active agents – Vocabulary, a process in which dirt (stains) are removed from their substratum and put into solution or into dispersion.[1] According to AS/NZ 4187, the removal of soil and a reduction in the number of microorganisms from a surface, by a process such as washing with detergent solution without prior processing.
Detergents	Any substance or preparation containing soaps and/or other surfactants intended for washing and cleaning processes. Detergents may be in any form (liquid, powder, paste, bar, cake, moulded piece, shape, etc.) and marketed for or used in households, or for institutional or industrial purposes.
Bio-accumulative	The tendency for a substance to be accumulated in an organism due to difference in the rate of intake and loss of the substance from the organism.
Biocide	Chemical substance or microorganism which can deter, render harmless, or exert a controlling effect on any harmful organism by chemical or biological means.[2]
Biocidal products	Active substances and preparations containing one or more active substances, put up in the form in which they are supplied to the user, intended to destroy, render harmless, prevent the action of, or otherwise exert a controlling effect on any harmful organism by chemical or biological means.[2]
Enzymes	Proteins that speed up the rate of chemical reactions without interacting in the reactions themselves.
ISO 14024 Type I Environmental label	A voluntary multicriteria-based, third party program that awards a license that authorises the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations.
EU Ecolabel	The ISO 14024 Type I environmental label from the European Union that is valid throughout Europe.
Surfactant	Any organic substance and/or preparation used in detergents, which has surface-active properties and which consists of one or more hydrophilic and one or more hydrophobic groups of such a nature and size that it is capable of reducing the surface tension of water, and of forming spreading or adsorption monolayers at the water air interface, and of forming emulsions and/or microemulsions and/or micelles, and of adsorption at water-solid interfaces.
Standard	A document established by consensus and approved by a recognised body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

[1] In the everyday sense, the effect of detergence is the cleaning of surfaces. It is the result of setting in motion many different physical-chemical phenomena. The dirt or stains are undesirable additions on the surface and/or inside the substratum

[2] Based on Regulation (EC) No 528/2012of the European parliament and of the council of 22 May 2012 concerning the making available on the market and use of biocidal products (L 167/1 OJEU 27.8.2012) Available from: http://ec.europa.eu/environment/chemicals/biocides/index_en.htm.

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1. INTRODUCTION

1.1 Background

The EU Ecolabel is a policy instrument designed to encourage the production and consumption of more environmentally friendly products and services through the certification and specification of products or services which have a reduced environmental footprint. They form part of the European Commission's action plan on Sustainable Consumption and Production and Sustainable Industrial Policy adopted on 16 July 2008.

The EU Ecolabel is a voluntary scheme coordinated by the European Commission[3] which is used to distinguish environmentally beneficial products and services. The EU Ecolabel is awarded to a product through a process in which an applicant has to demonstrate that the specified Ecolabel criteria for a particular product group are met. The successful applicant is then allowed to use the EU Ecolabel logo and advertise the product as having been awarded the EU Ecolabel.

1.2 Purpose of this document

This document forms part of the stages of revising the criteria for EU Ecolabel for hand dishwashing detergents. It encapsulates the activities and outputs of Tasks 1-4 (Definition and scope, Market analysis, Technical analysis and Product innovations and opportunities for improvement). This report represents a first evaluation of likely areas for investigation as a result of stakeholder surveys, market analysis, review of life cycle assessment (LCA) studies and known concerns with existing criteria including changes in hazardous substance classification of commonly used ingredients. It identifies where there is scope for strengthening the EU Ecolabel and which criteria should be removed, amended or further developed.

The information contained in this document provides an overview of changes to the hand dishwashing detergents market since the last revision of the criteria in 2011, and a technical analysis to understand where the greatest environmental impacts arise in their life cycle.

This report is also being used as a consultation document to gain feedback, evidence and opinion from stakeholders and experts on proposed changes and significant environmental issues.

1.3 EU Ecolabel for hand dishwashing detergents

The EU Ecolabel criteria for 'hand dishwashing detergents' (HDDs) were adopted in 2011 (Commission Decision 2011/382/EU).[4] The aim of these criteria was to promote HDDs that correspond to the top 10-20 % of environmental performing products available on the Community market considering the whole life cycle of production, use and disposal. These criteria are due to expire in 2016. A breakdown of the number of Ecolabel products for the HDD category can be found in the market analysis section of this report.

1.4 Investigation overview

The revision process takes the existing criteria document as the starting point and seeks to update these, taking into account technological and economic changes in the European market, relevant legislative change and improved scientific knowledge.

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[3] Regulation (EC) No 66/2010 of the European Parliament and the council of 25 November 2009 on the EU Ecolabel (L 27/1 OJEU 30.1.2010)

[4] Commission Decision (2011/382/EU) of 24 June 2011 on establishing the ecological criteria for the award of the EU Ecolabel to hand dishwashing detergents (C(2011) 4448) (L 169/40 OJEU 29.6.2011)

To review the existing EU Ecolabel, the following aspects have been investigated:

1) Product definition and categorisation, relevant legislation.
2) Economic and market analysis.
3) Technical analysis including environmental performance investigation.
4) Product innovations and improvement opportunities for hand dishwasher detergents.

2. LEGAL REVIEW, SCOPE AND DEFINITION

2.1 Introduction

The aim of the first task is to conduct a review of the practicality of the existing product group definition and scope. The areas where the existing criteria and scope are no longer in line with current legislation or alternative voluntary labelling schemes will be identified. The review will consider feedback from stakeholders, literature reviews, legal reviews and alternative ecolabels. The first task has been divided into the following sub-tasks:

1. An introduction to the existing product scope and definition
2. A summary of the feedback received from the stakeholder questionnaire
3. A review of existing EU legislation that is likely to affect the criteria revision
4. A review of alternative and national ecolabels for hand dishwashing detergent
5. The proposed scope and definitions for the hand dishwasher detergents category (abbreviated as HDD in this document).

2.2 Scope and definition

2.2.1 Product definition

Within the context of the EU Ecolabel and this report, the definition used for detergents is taken from the definition of detergents used in the Regulation (EC) No 648/2004 (the Detergents Regulation).[5]

> *'Detergent' means any substance or mixture containing soaps and/or other surfactants intended for washing and cleaning processes. Detergents may be in any form (liquid, powder, paste, bar, cake, moulded piece, shape, etc.) and marketed for or used in household, or institutional or industrial purposes.*

Before discussing in detail the classification of HDDs, it is important that certain key concepts of their composition are described. HDD formulations are made up of several components of which the major active component is surfactants. Other components of detergents include solubility enhancers, preservatives, fragrances, enzymes, dyes and opacifiers. As a result the overall composition of HDDs varies significantly and this affects the impact of the product on the environment and on human health. Further information on HDD ingredients can be found in Annex I.

2.2.2 Current EU Ecolabel product scope and definition

The Commission Decision 2011/382/EU[4] defines 'hand dishwashing detergents' as the following:

> *The product group 'hand dishwashing detergents' shall comprise all detergents intended to be used to wash by hand dishes, crockery, pots, pans, kitchen utensils and so on.*
>
> *The product group shall cover products for both private and professional use. The products shall be a mixture of chemical substances and must not contain microorganisms that have been deliberately added by the manufacturer.*

[5] Regulation (EC) No 648/2004 of the European Parliament and the council of 31 March 2004 on detergents(L 104/1 OJEU 8.4.2004) Available from: http://ec.europa.eu/enterprise/sectors/chemicals/documents/specific-chemicals/detergents/index_en.htm

2.3 Feedback from stakeholder consultation

In order to obtain feedback on the current EU Ecolabel product scope and definition for HDDs, a questionnaire was sent to stakeholders. A blank copy of the questionnaire can be found in Annex II. The target groups for the questionnaire were European Ecolabel competent bodies, industry, technology institutes and trade associations. Ten stakeholders formally responded to the consultation by returning the completed questionnaire. The respondents feature a mixture of stakeholders, as summarised in Table 1.

Table 1: Summary of respondents to questionnaire

Stakeholder	Number of respondents
Competent bodies	4
Environment Agency	5
Industry	5
Consulting agency	
Testing institute	2
Industry association	2

The responses and comments from stakeholders gathered from the questionnaire are presented in Table 2 and Table 3. These responses will be used along with scientific evidence to direct the revision of the criteria for the HDD product category.

Table 2: Summary of responses to the stakeholder questionnaire

Criterion	Existing EU Ecolabel Criteria	Questions	Number of responses		
			Yes	No	N/A
Scope and definition	The product group 'Hand Dishwashing Detergents' comprises all detergents intended to be used to wash by hand dishes, crockery, cutlery, pots, pans, kitchen utensils and so on. The product group shall cover products for both private and professional use. The products shall be mixtures of chemical substances and must not contain micro-organisms that have been deliberately added by the manufacturer.	Do you find the existing product group definition easy to understand?	17		1
		Is the current definition appropriate and suitable for this product?	17		1
		Is the current definition of hand dishwashing detergents excluding any type of product that should be included?	4	14	
1. Toxicity to aquatic organisms: Critical Dilution Volume (CDV)	The current criteria specify that the critical dilution volume of the product must not exceed the following limits (CDVchronic): **Product type** | **$CDV_{chronic}$** Hand dishwashing detergents | 3800 L/1 L of solution	Is the CDV limit strict enough?	10	5	3
		Is CDV the most appropriate method for assessing aquatic toxicity? If not, which assessment method should be considered?	12	2	4
2. Biodegradability of surfactants	The current criteria specify that each surfactant in the product shall be readily biodegradable (aerobically). For anaerobic biodegradability of surfactants the following requirements apply: **Feature** | **Criterion** Surfactants classified as H400/R50 | None permitted Total weight of anaerobically non-biodegradable surfactants that are not classified as H400/R50 | < 0.20 g/1 L of dishwashing water	Are requirements for anaerobic biodegradability necessary for this product group? Which other parameters could be considered?	6	6	6
		Are the current limits effective in distinguishing between the state-of-the-art and the best environmentally performing products in the HDD product group?	5	7	6
		Are the current limits set for anaerobic biodegradability of surfactants strict enough?	9	5	4
3. Excluded or limited substances and mixtures	The following ingredients must not be included in the product: • APEO (alkyl phenolethoxylates) and derivatives thereof • EDTA (ethylenediamine tetraacetic acid) • 5-bromo-5-nitro-1,3-dioxane • 2-bromo-2-nitropropane-1,3-diol • diazolinidylurea • formaldehyde • sodium hydroxyl methyl glycinate • nitromusks and polycyclic musks.	Are there any additional ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?	5	8	5
		Are any additional derogations required?	2	9	6
		Are there any substances or mixtures which no longer need to be excluded?	4	8	6
		Are further requirements needed for the use of biocides in the product?	3	8	7

<table>
<tr><th>Criterion</th><th>Existing EU Ecolabel Criteria</th><th>Questions</th><th colspan="3">Number of responses</th></tr>
<tr><th></th><th></th><th></th><th>Yes</th><th>No</th><th>N/A</th></tr>
<tr><td></td><td>There are restrictions on the use of quaternary ammonium salts and biocides.

The following derogations are in place:<table><tr><th>Substance</th><th>Hazard statement</th><th>Risk phrase</th></tr><tr><td>Surfactants (in concentrations <25 % in the product)</td><td>H400 and H412</td><td>R50 and R52-53</td></tr><tr><td>Fragrances</td><td>H412</td><td>R52-53</td></tr><tr><td>Enzymes</td><td>H334 and H317</td><td>R42 and R43</td></tr><tr><td>NTA as in impurity in MGDA and GLDA</td><td>H351</td><td>R40</td></tr></table></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4. Fragrances</td><td>Under the current criteria the following requirements on fragrances apply:
a) Nitro- and polycyclic musk-based fragrances are prohibited as in Criterion
b) Any substance added to the product as a fragrance must have been manufactured and/or handled in accordance with the code of practice of the International Fragrance Association. The code can be found on IFRA's website: http://www. ifraorg.org
c) Other fragrances may be limited to < 100 ppm (g/g) by the requirements of Regulation (EC) No 648/200 (Annex VII) or where they are classified H317/R43 may cause allergic skin reaction and/or H334/R32 may cause allergy or asthma symptoms or breathing difficulties if inhaled.
d) Fragrances are not permitted in HDDs for professional use.</td><td>Are there any additional fragrance ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?</td><td>1</td><td>12</td><td>5</td></tr>
<tr><td></td><td></td><td>Are there any further requirements needed for fragrances?</td><td>5</td><td>7</td><td>6</td></tr>
<tr><td>5. Corrosive properties</td><td>The current criteria state that the product shall not be classified as a 'Corrosive' (C) mixture with R34 or R35 in accordance with Directive 1999/45/EC, or as a 'Skin Category 1' mixture in accordance with Regulation (EC) No 1272/2008.</td><td>Are the requirements on corrosive properties sufficient?</td><td>13</td><td></td><td>5</td></tr>
<tr><td>6. Packaging requirements</td><td>The existing criteria specify the following requirements on packaging:
a) Plastics that are used for the main container must be marked in accordance with EC Directive 94/62/EC or DIN 6120 part 1 and 2 in connection with DIN 7728 part 1.
b) If the primary packaging is made of recycled material, any indication of this on the packaging shall be in conformity with the ISO 14021 standard</td><td>Do you think that is it necessary to have a criterion on packaging requirements for this product group?</td><td>12</td><td>3</td><td>3</td></tr>
<tr><td></td><td></td><td>Are the WUR limits acceptable for HDDs currently on the market?</td><td>8</td><td>5</td><td>5</td></tr>
<tr><td></td><td></td><td>Should additional criteria be set to further</td><td>3</td><td>12</td><td>3</td></tr>
</table>

Criterion	Existing EU Ecolabel Criteria	Questions	Number of responses		
			Yes	No	N/A
	c) Only phthalates that at the time of application have been risk assessed and have not been classified according to criterion 3c may be used in the plastic packaging d) The weight utility ratio (for primary packaging) must not exceed the following values: 1.2 g/L use solution	promote the use of recycled materials in packaging?			
		Should there be restrictions on combinations of materials used for packaging? For instance to encourage design for recycling (like the new proposed criterion for rinse-off cosmetics).	2	11	5
7. Washing performance (fitness for use)	The existing criteria state that the product shall be fit for use, meeting the needs of the consumer. The criteria state that the product shall comply with the performance requirements as specified in the latest version of the EU Ecolabel HDD performance test which can be found here: http://ec.europa.eu/environment/ecolabel/documents/performance_test.pdf	Stakeholders were asked to provide comments – see comments section	5	5	
8. User instructions	Under the existing criteria, the product shall bear the following information on the packaging: a) 'Do not use running water but immerse the dishes, and use the recommended dosage' (or equivalent text) b) Information on the recommended dosage shall appear on the packaging in a reasonably sufficient size and against a visible background. The information shall be provided in millilitres (and tea spoons) of product for 5 litres of dishwashing water suitable for 'dirty' and 'less dirty' dishes. c) An indication of the approximate number of washes that the consumer can perform with one bottle is recommended but voluntary.	Are additional requirements and instructions for dosage needed?	6	9	3
9. Information appearing on the EU Ecolabel	An optional label with text box shall contain the following text: • Reduced impact on aquatic life • Reduced use of hazardous substances • Reduced packaging waste Clear user instructions	Is there any other information which should be included on the EU Ecolabel claims text?	1	13	4

Table 3: Summary of the comments received from stakeholders in response to the questionnaire

Criterion	Question	Comment
Scope and definition	Do you find the existing product group definition easy to understand?	No comments
	Is the current definition appropriate and suitable for this product?	
	Is the current definition of hand dishwashing detergents excluding any type of product that should be included?	
1. Toxicity to aquatic organisms: CDV	Is the CDV limit strict enough?	Higher strictness for the CDV limit was assessed as possible by the stakeholders. Indeed, it was commented that existing products have much lower CDV values than the thresholds and even concentrated products have no difficulties in complying with the criterion. It was suggested that a value of 2500litres/litre of solution is possible.
	Is CDV the most appropriate method for assessing aquatic toxicity? If not, which assessment method should be considered?	Stakeholders commented that they did not have enough information about alternative methods. It was also suggested that the most appropriate method to assess the aquatic toxicity of the dishwashers would be an environmental risk assessment. CDV is a hazard approach that evaluates ingredient by ingredient the hazard and does not follow REACH approach.
2. Biodegradability of organics	Are requirements for anaerobic biodegradability necessary for this product group? Which other parameters could be considered?	Some stakeholders suggested that anaerobic biodegradability is not a relevant environmental parameter and instead of it, research on the availability of the raw materials regarding the anaerobic biodegradability should be performed. Other stakeholders commented on the fact that detergents EU Ecolabels should align with the rinse-off cosmetics EU Ecolabel and promote high standards and, thus, should require anaerobic biodegradability for surfactants.
	Are the current limits effective in distinguishing between the state-of-the-art and the best environmentally performing products in the HDD product group?	Anaerobic biodegradability does not define the environmental performance of surfactants, if they are already readily biodegradable (aerobically). Additionally it was pointed out that there are products that contain surfactants that are anaerobically biodegradable.
	Are the current limits set for anaerobic biodegradability of surfactants strict enough?	Different points were arisen for this question. Stakeholders consider that the current limits are too strict although the anaerobic biodegradability is not a relevant parameter from the environmental point of view. The limit of 0.20g/1L was mentioned as being too high and some stakeholders said that all surfactants should be anaerobically biodegradable.
3. Excluded or limited substances	Are there any additional ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?	Endocrine disruptors, vPvB, PBT and SVHC, enzymes, quaternary ammonium salts, chloromethylisothiazolinone.

Criterion	Question	Comment
and mixtures	Are any additional derogations required?	Derogations for H400 for enzymes & H411 for surfactants were named. Derogations similar to the amendment made to the I&I laundry and dishwashing detergents criteria could be considered since the derogation for surfactants classified as H411 <2.5 %, is not included in this document yet and some proteases can be classified as H400. Possible derogations for H317 and H412 for preservatives.
	Are there any substances or mixtures which no longer need to be excluded?	APEO: are not used due to their limited biodegradability, NTA.
	Are further requirements needed for the use of biocides in the product?	Research on more sustainable preservatives could be useful.
4. Fragrances	Are there any additional fragrance ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?	
	Are there any further requirements needed for fragrances?	Fragrances should be allowed in professional products. A revision of the CDV calculation of fragrances was requested by the stakeholders. It was commented that actually a total (100 %) concentration for every perfume is needed while the inclusion of the CDV calculation for every ingredient (if available) would be better and would stimulate the use of more sustainable fragrances.
5. Corrosive properties	Are the requirements on corrosive properties sufficient?	According to the response, industry initiatives such as Detnet should also be considered.
6. Packaging require-ments	Do you think that is it necessary to have a criterion on packaging requirements for this product group?	An affirmative response was received because the packaging of these products is ultimately part of the package purchases by the final consumer. On the other hand it was also pointed out that too strict requirements on packaging could lower its quality and lose customers.
	Are the WUR limits acceptable for HDDs currently on the market?	No agreement on this point was reached. On the one hand, comments were received regarding the high strictness of this criterion (especially considering the low environmental impact caused by packaging in comparison to the dishwasher itself) and on the other hand, it was commented that this limit could be stricter to be in line with other national schemes such as Nordic Swam.
	Should additional criteria be set to further promote the use of recycled materials in packaging?	Several opinions were commented on this point. For example, it was pointed out the need of keeping in mind that although recycled materials are increasingly available on the market and it would be good to stimulate recyclability, any recycling criteria should go beyond the current limits of this market. Other alternatives such as the bio-based plastics and new forms of packaging materials were suggested to be investigated since they can also reduce the environmental impacts.
	Should there be restrictions on combinations of materials used for packaging? For instance to encourage design for recycling (like the new	An agreement on the existence of restrictions on combinations of materials used for packaging was expressed by several stakeholders. Non-compatible materials have been identified as the major barrier to increase the recyclability rate of packaging. However, several points were

Criterion	Question	Comment
	proposed criterion for rinse-off cosmetics).	proposed to be further analysed, among them: - certain kind of packaging that cannot be recycled at all and for which there are efficient and economically viable alternatives with the same functionality on the market should be banned - restriction should be studied for the use of low weight laminated pouches that have several environmental advantages, but that, however, are difficult materials to be recovered - easy-to-empty, easy-to-access and easy-to-separate concepts could also make easier the recycling process
7. Washing perform-ance (fitness for use)	Please provide us with your comments on the washing performance test and, if appropriate proposals for modification	Different opinions were expressed regarding the washing performance tests. On the one side, it was commented that the lab tests are not relevant for use in practice, such as the foam criteria, and bring unnecessary costs and the protocols should require fewer parameters. On the other side, it was stated that the IKW test protocol is sufficient if the current five repetitions are increased up to 20 repetitions. Additionally, it was suggested that a chemical characterization should be attached to the performance tests to allow further quality control.
		Ingredients for the soil preparation should be available locally (at least within one country). Instead of 'local' source or 'not specified' some clarifications are needed because the use of specific ingredients can one-sidedly influence the plate numbers. Concerning this matter, the reference product is unfortunately rather robust.
8. User instruct-ions	Are additional requirements and instructions for dosage needed?	Several additional requirements and instruction were suggested: - More exact measuring units should be included e.g. "in millilitres (and teaspoons) for consumer products and in millilitres for professional products", - including several choices replacing and by or, - expressing the dosage per litre of water because professional sinks are often bigger than 5 litres, - advise the customer to apply for a rinse step after the hand wash, - make the meanings of "dirty" and "normally soiled" clearer.
9. Inform-ation appearing on the EU Ecolabel	Is there any other information which should be included on the EU Ecolabel claims text?	Add a claim on the performance of products.
0. Further issues or hot spots for HDDS	Should further criterion be developed, either because all the issues are not already covered or because of recent developments which affect the environmental performance of HDDs?	Other issues to be included into the scheme are: - sustainable sourcing of materials (e.g renewable materials) can be assessed by schemes already in place - professional use training and/or product information sheets to stimulate sustainable use
	Do you consider it feasible to link the CDV and	An agreement on the no-linkage between CDV and the performance criteria was expressed. Two

Criterion	Question	Comment
	performance criteria? If yes, please explain your approach	examples were added: fragrances dominate CDV score but do not contribute to the technical performance and acidify materials with low CDV score are bad degreasers
	Do you know of any examples of the use of nanomaterials in HDDs? Should their use be banned from this product group and why?	Although no examples were given, nanomaterials should be banned in relation with possible health concern.

2.3.1 Summary of stakeholder recommendations for revision of existing criteria

Based on the feedback received from the stakeholders, we recommend that the revision of the criteria should focus on the following areas: aquatic toxicity, anaerobic biodegradability, review of excluded ingredients, packaging, washing performance, user instructions and renewable raw materials.

Following the review of stakeholder feedback and alternative ecolabels and voluntary agreements, suggested changes to the criteria have been collated. A summary of the relevant suggested changes and further actions to be taken are summarised in Table 4.

Table 4: Summary of suggest changes for HDD

Criterion	Suggested change	Further action
Toxicity to aquatic organisms	CDV limit could be lowered, 2500 is possible.	Further stakeholder engagement required.
	Adjust CDV values according to changes in product formulation since last revision	Acquire CDV limits of HDD products from industry and competent bodies, and then check these values against the current limits.
Biodegradability of surfactants	Stakeholders suggested that the requirements are too strict for anaerobic biodegradability	Further investigation required into the availability of surfactants for HDD which are anaerobically biodegradable.
Excluded or limited substances	Exclude endocrine disruptors	Investigate the use of endocrine disruptors in APC products and how they are dealt with in EU regulations.
	Derogation for enzymes with H400	Further investigation into the use of enzymes with this classification is required.
	Exclude nanomaterials	Further investigation on the use of nanomaterials in APCs is required.
	Exclusion for no longer required for APEO	As it does not meet requirements of Detergents Regulation.
	Subsitilisin	Apart from the feedback received through the stakeholders consultation, DG ENV received a request for derogating the enzyme subsitilisin that has recently changed classification
Packaging requirements	WUR limits should be revised, some stakeholders think that they are too strict	Further investigation into packaging used for HDD products is required.
	Add criteria to encourage ease of recycling	Align with approach taken for rinse-off cosmetics.
Washing performance	Ingredients for the soil preparation should be general available instead of local source	Review soil preparation for fitness for use test and ensure that ingredients used are available in most EU countries.
User instructions	For professional use, dosage should be in ml per litre.	Further investigation required on typical dosage instructions for professional HDD products.
Dosage	Dosage in teaspoons is not relevant for professionals	Add clarification that dosage in ml and teaspoons is only required for products intended for consumer use.
Additional criteria	Sustainable sourcing of palm oil derivatives	Further information to assess the relevance of a criterion for sustainable sourcing of palm oil derivatives.

2.4 Review of legislation – key changes since the 2011 revision

2.4.1 Regulation EC/66/2010 (the EU Ecolabel Regulation)

Regulation EC/1980/2000[6] on a *revised Community eco-label award scheme* was replaced by Regulation EC/66/2010[7] on the *EU Ecolabel* (the EU Ecolabel Regulation) to increase its effectiveness and streamline its operation.

A number of key changes, relevant to this product group, were incorporated:

1) Criteria would be determined on a scientific basis (Ecolabel Regulation - Art.6.3)
2) There would be a focus on the most significant environmental impacts over the product life cycle (Ecolabel Regulation - Art.6.3.a)
3) The substitution of hazardous substances with safer substances (Ecolabel Regulation – Art.6.3.b)
4) Any substances classified according to Regulation (EC) No 1272/2008 (The CLP Regulation)[8] as hazardous to the environment, toxic, carcinogenic, mutagenic or toxic for reproduction and referred to in Art.57 of Regulation EC/1907/2006 (the REACH Regulation) would be restricted (EU Ecolabel Regulation - Art.6.6)
5) Derogations may be given in respect of the above, if substitution or use of alternative materials is not technically feasible. However no derogations are possible in respect of substances of very high concern (SVHC) identified in accordance with the procedure set out in REACH - Art.59 (EU Ecolabel Regulation - Art.6.7).

In developing practical means to implement the Regulation, the EU Ecolabelling Board has identified the hazard classifications for substances and preparations which would be restricted in all product criteria.

2.4.2 Regulation (EU) No 259/2012 (the Detergents Regulation)

In 2012 the Detergents Regulation (Regulation (EU) No 259/2012)[9] was revised. The Detergent Regulation amends the Regulation (EC) No 648/2004 (the Detergents Regulation 2004)[10] and limits the use of phosphates and phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents (CADDs) in the EU-28, to reduce their contribution to eutrophication and to reduce the cost of their removal during waste water treatment. The limit applies to all phosphorus compounds, so that they are not simply substituted for each other. However, this revision does not apply to HDDs but this product category may be covered in future revisions.

One Member State and one EEA State have been allowed to maintain in place national phosphorus limits that are stricter than the Detergents Regulation 2012:

- Since July 2011, Sweden has restricted the authorised phosphate content of detergents to 0.5 %, and intends to maintain these rules until further notice, whilst also waiting for the evaluation of the Commission (according to Art.16 of the Regulation). This exception is valid until 1 January 2017.
- Norway prohibits the manufacture, import and sale of HDDs with phosphorus content of 0.2 % or higher (by overall weight). This exception is valid until 1 January 2017.

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[6] Regulation (EC) No 1980/2000 of the European Parliament and of the Council of 17 July 2000 on a revised Community eco-label award scheme

[7] Regulation (EC) No 66/2010 of the European Parliament and of the Council of November 25 2009 on the EU Ecolabel.

[8] 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

[9] Regulation (EU) No 259/2012 of the European Parliament and of the Council of 14 March 2012 amending Regulation (EC) No 648/2004 as regards the use of phosphates and other phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents (30.3.2012 OJEU L 94/16)

10 Regulation (EC) No 648/2004 of the European Parliament and of the Council of 31 March 2004 on detergents (8.4.2004 OJEU L 104/1)

2.4.3 Regulation (EU) No 528/2012 (the Biocidal Product Regulation)

The Directive (98/8/EC) [11] (the Biocidal Products Directive or BPD) applies to insecticides and products that have anti-microbial properties, this includes disinfectants. In household cleaning products biocides may be used in small amounts as preservatives to maintain product quality and/or as disinfectants.[12] The original BPD regulated the placing of biocidal products on the EU market. The BPD applied only to products containing active agents that imparted biocidal properties to the product into which they were incorporated.

When the BPD went into force, it was already being criticized as too complicated and inadequate in some respects. Demands for simpler and quicker authorization procedures and, EU-wide authorization came especially from industry. Authorities from the Member States called for uniform testing and evaluation during authorization and consumer and environmental non-governmental organizations criticized the lack of rules on articles treated with biocides and on biocide use phases.

Regulation EU/528/2012[13] (the BPR) *concerning the making available on the market and use of biocidal products* repeals and replaces the BPD. Due to the requirements mentioned above the BPD was reviewed and implemented some modifications concerning: prohibiting the use of active biocidal substances with extremely hazardous profiles; authorization by Member States of active substances if the exposure to humans or the environment is negligible; labelling substitution candidates of the substances that will be gradually replaced; and, overall, simplifying and expediting authorization procedures for products in the entire European market. In this respect, the BPR includes the stepwise introduction of union authorization by 2020 with an increase in the transparency of the process. Finally the BPR increases the consumer protection as a higher number of substances cannot be made available to the general public and further information will be available on-line.

Under BPR, the mandate for the regulation of biocidal products has been transferred to the European Chemicals Agency (ECHA), with the aim being further convergence with the biocidal requirements of REACH. The BPR also establishes a *Register for Biocidal Products*, which allows the Member States, the Commission and ECHA to make available to each other the particulars and scientific documentation submitted in connection with applications for authorisation of biocidal products.

2.4.4 Regulation (EC) No 1272/2008 (The CLP Regulation)

The use of many (often incompatible) national systems for providing information on hazardous properties and control measures of chemicals requires multiple labels and Safety Data Sheets (SDSs) for the same product. This causes confusion for customers of these chemicals and increases the burden on companies complying with many different regulations. To address this, the CLP Regulation[14] on the Classification, Labelling and Packaging of Substances and Mixtures was developed to harmonise the process, requiring only one set of labels for all products sold throughout the EU.

The CLP Regulation entered into force on 20 January 2009 and implemented the UN Globally Harmonised System at EU level. The new system of classification, labelling and packaging was implemented by 1 December 2010 for substances, and will be implemented by 1 January 2015 for mixtures. However, substances and mixtures will still have to be classified and labelled according to the predecessor Directive 67/548/EEC[15] (the

[11] Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market

[12] Scientific Committee on Emerging and Newly Identified Health Risks SCENIHR, Assessment of the Antibiotic Resistance Effects of Biocides, EC DG-SANCO, 2009. Available from: http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_021.pdf

[13] Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

[14] 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 (31.12.2008 OJEU L 353/1)

[15] Directive of 27 Tune 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (67/548/EEC) (16.8.67 OJEC No 196/1)

Dangerous Substances Directive) and Directive 1999/45/EC[16] for preparations until 1 June 2015.

2.5 Review of national Ecolabels

As well as the EU Ecolabel, which operates Europe-wide, there are national labels in Europe that can be sought out for HDDs, including 'Nordic Swan' (Nordic Countries) and the Austrian Ecolabel. A number of labels are also used outside the EU, including 'Green Seal' (predominantly used in the USA) and the 'Environmental Choice' labelling programme (New Zealand).[17] The aim of this section is to identify where these alternative ecolabels have product categories for HDDs. As the EU Ecolabel is a multi-attribute certification, only multi-criteria ecolabels will be compared in this section. An overview of the alternative voluntary labelling schemes, including industry voluntary agreements, is presented in Table 5 .

A search on standards conducted as part of this study found that there were no standards relating directly to HDDs. Instead standards were mostly found relating to testing of washing performance and attributes of ingredients found in detergents. These have not been included in this study.

Table 5: Alternative voluntary labelling schemes

Labelling program	Region	Product category	Date of adoption/last revision
Nordic Swan	Denmark, Finland, Iceland, Norway, Sweden.	Hand dishwashing detergents[18]	Version 5.0: 21 March 2012 – 31 March 2016
Blue Angel	Germany	No criteria for HDD	N/A
Austrian Ecolabel	Austria	UZ19 Hand dishwashing detergents	Version 5.1 issued July 2011
Bra Miljöval (Good Environmental Choice)	Sweden	Chemical products[19]	Last issued 2006
Czech Ecolabelling[20]	Czech Republic	Detergents for hand dishwashing[21]	Last issued 2012
Ecocert	Global (founded in France)	Natural detergents and Natural detergents made with organic[22]	Last revised May2012
Green Seal	USA	GS-52 Specialty cleaning for household products[23]	Last issued July 2013
		GS-53 Specialty cleaning products for industrial and institutional use[24]	Last issued July 2013

[16] Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations (30.7.1999 OJEC L 200/1)

[17] Information on ecolabels on detergents, including hand dishwashing detergents can be found on the following website: http://www.globalecolabelling.net/categories_7_criteria/list_by_product_category/1300.htm

[18] Nordic Ecolabelling of Hand dishwashing detergents, 025 Hand dishwashing detergents, version 5.0, 28 May 2012. Available from http://www.nordic-ecolabel.org/criteria/product-groups/

[19] Good Environmental Choice criteria: Chemical products, Version 2006:4, Swedish Society for Nature Conservation, available from: http://www.naturskyddsforeningen.se/sites/default/files/dokument-media/bra-miljoval-engelska/bmv-kem-chemical-crit.pdf

[20] http://www.ekoznacka.cz/

[21] Technical Guidelines, Detergents for hand dishwashing, V67, 2012, Ministry of Environment available from: http://www.cenia.cz/web/www/web-pub2.nsf/$pid/MZPMSFHMV9DV/$FILE/672012.pdf

[22] Ecocert Standard: Natural detergents and natural detergents made with organic, May 2012, Ecocert Greenlife SAS, available from: http://www.ecocert.com/sites/default/files/u3/Natural-Detergents-made-with-Organic-Ecocert-Greenlife-11.05.2012.pdf

[23] Green Seal Standard for speciality cleaning products, GS-52 Edition 2.2 April 2014. Available from: http://www.greenseal.org/GreenBusiness/Standards.aspx?vid=ViewStandardDetail&cid=2&sid=38

Labelling program	Region	Product category	Date of adoption/last revision
Environmental Choice	New Zealand	EC-01-14 Hand Dishwashing Detergents[25]	Last issued January 2014
Korea Eco-Label	Korea	No criteria for HDD	N/A
AISE Charter for Sustainable Cleaning	Europe	Household Manual Dishwashing Detergents[26]	Last issued January 2014
Singapore Green Label	Singapore	Dishwashing Detergents[27]	Last issued May 2013
Good Environmental Choice Australia	Australia	Hand Dishwashing Detergents[28]	Last issued January 2006
Green Choice	Philippines	Liquid dishwashing[29]	Last issued 2008
Green Label Scheme	Hong Kong	Hand dishwashing detergents[30]	Last issued 2010
Green Mark	Chinese Taipei	Dishwashing detergents[31]	Last issued January 2012

Nordic Swan[32]: The Nordic Swan became the official Ecolabel for the Nordic countries in 1989. It is a voluntary scheme that used a life cycle based approach to evaluate a product's impact on the environment. At present there are 63 product categories covered by the Nordic Swan; these include products and services. Each Nordic country has a national office which is responsible for licensing, auditing, marketing and criteria development. As per the EU Ecolabel, the Nordic Swan uses the same DID list for data on ingredient ecotoxicity and degradability.

Austrian Ecolabel[33]: The Austrian Ecolebel scheme was created in 1990 as an initiative by the Austrian Environment Ministry. The intention of the label is to inform the public about the environmental impacts of products and services. The Ecolabel covers products, services, as well as schools and other educational institutions. The standards are based on the principle of life cycle assessment and cover four main areas: consumption of raw materials and energy, waste and emission, marketing and transportation, disposal and recycling.

Bra Miljöval (Good Environmental Choice)[34]: Good Environmental Choice (or Bra Miljöval in Swedish) is the ecolabelling system established by the Swedish Society for Nature Conservation. An LCA-based approach is employed for the testing and award procedure. At present the system covers 11 product areas including chemical products.

Czech Ecolabelling[35]: The Czech Ecolabel was launched in 1994 and is administered by CENIA, the Czech Environmental Information Agency. The Ecolabel covers a wide range of products and services, and for many of these it employs the EU Ecolabel criteria. The criteria for product groups which exist in both labelling schemes are gradually being unified.

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[24] Green Seal Standard for speciality cleaning products for industrial and institutional use, GS-53 Edition 2.2 April 2014. Available from: http://www.greenseal.org/GreenBusiness/Standards.aspx?vid=ViewStandardDetail&cid=2&sid=42

[25] The New Zealand Ecolabelling Trust: Licence criteria for hand dishwashing detergents, EC-01-14, January 2014. Available from: http://www.environmentalchoice.org.nz/docs/publishedspecifications/ec0114_hand_dishwashing_detergents.pdf

[26] AISE Charter for Sustainable Cleaning: Advanced sustainability profiles for household manual dishwashing detergents, 2014. Available from: http://www.sustainable-cleaning.com/content_attachments/documents/ASPs_MDW_1January2014.pdf

[27] Singapore Green Labelling Scheme Certification Guide: Dishwashing Detergents, May 2013. Available from: http://www.sec.org.sg/sgls/standards-criteria.php

[28] The Australian Ecolabel Program: Cleaning Products, Version 2.2 November 2013. Available from: http://www.geca.org.au/media/medialibrary/2012/08/GECA_15-2006_Hand_Dishwashing_Detergents_May_2012.pdf

[29] Green Choice Philippines, GCP 2008031 Liquid dishwashing, 2008. Available from: http://www.pcepsdi.org.ph/downloads.html

[30] Hong Kong Green Label Scheme, Product environmental criteria for Hand dishwashing detergents (GL-003-004), 2010. Available from: http://www.greencouncil.org/hkgls/GL003004_ver2.pdf

[31] Chinese Taipei Green Mark criteria for Dishwashing Detergents (25), 2012. Available from: http://greenliving.epa.gov.tw/GreenLife/uploadfiles/Criteria/25/465c9ca4-48fd-4f28-95a2-84b4ec4bf90f.pdf

[32] More information available at: http://www.nordic-ecolabel.org/

[33] More information available at: http://www.umweltzeichen.at/cms/home/produkte/content.html

[34] More information available at: http://www.naturskyddsforeningen.se/in-english

[35] More information available at: http://www1.cenia.cz/www/ekoznaceni/ekologicky-setrne-vyrobky

Ecocert[36]**:** Ecocert is an inspection and certification body founded in France in 1991. Its focus is on sustainable development and organic agricultural products. Ecocert develops internationally recognised standards for products, systems and services. The product categories include natural cleaning products, paintings and coatings from natural origin and inputs eligible for use in organic farming. The basic principle of the label is to protect our planet and its resources, to protect and inform the consumer and to reduce unnecessary waste and discharges. In France Ecocert is accredited by the French Accreditation Committee (Cofrac).

Green Seal[37]**:** Green Seal is an independent non-profit certification organisation that operates in the USA and was established in 1989. Green Seal uses a life cycle approach to evaluate the environmental impacts of products, services and companies. It develops its criteria for product categories with input from industry, government, academia and the public.

Environmental Choice (New Zealand): The Environmental Choice ecolabel is operated by the New Zealand Ecolabelling Trust and is endorsed by the New Zealand government. The ecolabel was launched in 1992 and has standards based on life cycle considerations, for a wide range of products, services and companies

Korea EcoLabel: The Korean Ecolabel was launched by the government of the Republic of Korea in 1992. The label uses a life cycle based approach and is verified by an independent organisation. The Korea Eco-Label covers a wide range of products and services.

The Charter for Sustainable Cleaning: This charter is a voluntary initiative of AISE.[38] The charter aims to encourage both consumers and industry to adopt more sustainable approaches to cleaning. The charter is based on a life cycle analysis and covers initiatives and activities ranging from human and environmental safety of chemicals and products, to eco-efficiency, occupational health and safety, resource use and consumer information. In order to participate in the program, companies must report annually on key performance indicators. The charter has an advanced sustainability profile (ASP) for Household Manual Dishwashing Detergents.[39] The ASPs are sustainability criteria which have been created for each AISE product category, taking into account a life cycle approach. However, there are no limits values set for environmental impacts such as aquatic toxicity and biodegradability. The ASP for a given product category describes the product group characteristics which the industry considers represent a good sustainability profile.

Singapore Green Label: The Singapore Green Label Scheme was launched by the Ministry of the Environment in 1992. Since 1995 the scheme has been run by the Singapore Environment Council (SEC), who are an independently managed non-profit and non-government organisation. The green label considers overall product environmental impacts such as raw materials, manufacturing process, health impacts and disposal. The label covers a wide range of products, but does not cover services and processes. In addition there are five levels of certification: basic, bronze, silver, gold and platinum. Products are scored across all five criteria categories and the overall certification level is equal to the lowest score in any category.

Good Environmental Choice Australia: The Australian Good Environmental Choice program was launched in November 2011 and is currently managed by a not for profit organisation. The program is complaint with ISO 14024 and provides standards for a wide range of products and services. The scheme aims to enable consumers to choose certified products and standards and have confidence that they have a lower impact on the environment, human health and address important social considerations.

Green Choice Philippines: Launched in 2008, the National Ecolabelling Programme - Green Choice Philippines (NELP-GCP) is a voluntary, multiple criteria-based, and third party programme that aims to encourage clean manufacturing practices and consumption of environmentally preferable products and services. This

[36] More information available at: http://www.ecocert.com/
[37] More information available at: http://www.greenseal.org/Home.aspx
[38] More information available at: http://www.sustainable-cleaning.com/en.home.orb
[39] More information available at: http://www.sustainable-cleaning.com/content_attachments/documents/ASPs_MDW_1January2014.pdf

government project is seen as an important marketing instrument to complement laws and regulations for environmentally preferable products and a guide to consumers' purchasing preferences. The project is under the auspices of the Department of Trade and Industry and the Department of Environment and Natural Resources.

Hong Kong Green Label Scheme: The Hong Kong Green Label Scheme (HKGLS) is an independent, non-profit-making and voluntary scheme for the certification of environmentally preferable products launched in December 2000 by Green Council (GC). The scheme sets environmental standards and awards its 'Green Label' to products that are qualified regarding their environment attributes and/or performance. As with all ecolabelling schemes, the aim is to encourage manufacturers to supply products with good environmental performance and provide a convenient means for consumers to recognise products that are more environmentally responsible, thus promoting a more sustainable pattern of consumption.

Chinese Taipei Green Mark: The Green Mark Program is the official eco-labelling program in Chinese Taipei which was founded in 1992 by the Environmental Protection Administration (TEPA). At present, the Program has issued Green Mark eco-label certificates to nearly 6,000 products under 112 product categories, including various cleaning products, office supplies and equipment, energy/water-saving products, home appliances, information technology products, construction materials, etc. The Program is instrumental in the government's green procurement program which has been in place since 2002, as the Green Mark products are designated as the top priority products for government agencies and all publicly-owned enterprises/schools/hospitals to choose from.

In addition to feedback from the stakeholders, the current scope and definition of the EU Ecolabel criteria for HDD have also been compared to those of other national ecolabelling schemes. An overview of the Ecolabelling schemes and the product definitions used (for the schemes which provide product definitions) is given in Table 6. It should be noted that not all standard documents for ecolabels provide category or product definitions.

Table 6: Product group definitions and scope from alternative voluntary labelling schemes

Labelling program	Product category	Definitions & scope
EU Ecolabel	Hand dishwashing detergents	The product group 'hand dishwashing detergents' shall comprise all detergents intended to be used to wash by hand dishes, crockery, cutlery, pots, pans, kitchen utensils and so on. The product group shall cover products for both private and professional use. The products shall be a mixture of chemical substances and must not contain microorganisms that have been deliberately added by the manufacturer.
The Nordic Swan	Hand dishwashing detergents	Liquid hand dishwashing detergents for the retail market and for professional use can be Nordic Ecolabel. The primary function of the product is as a detergent for hand dishwashing. Products that are intended for disinfection or to prevent the growth of micro-organisms (e.g. bacteria) are not included in the product group. Products are considered professional if more than 80 % of sales are to the professional market.
Austria Ecolabel	Hand dishwashing detergents	Same definition as used in the EU Ecolabel
Sweden Bra Miljöval (Good Environmental Choice)	Chemical products	Washing-up liquids**:** Products that are used for hand washing porcelain, glass, kitchen utensils and the like.

Labelling program	Product category	Definitions & scope
Czech Ecolabelling	Detergents for hand dishwashing	Same definition as used in the EU Ecolabel
Ecocert[40]	Natural detergents and Natural detergents made with organic	Any substance or preparation containing soaps and/or other surfactants intended for washing and cleaning processes. Detergents may be in any form (liquid, powder, paste, bar, cake, moulded piece, shape, etc.) and marketed for or used in household, or institutional or industrial purposes.
New Zealand Environmental Choice	EC-01-14 Hand Dishwashing Detergents	This category includes all liquid hand dishwashing detergents for household use, the main function of which is washing up by hand.
Singapore Green Label	Dishwashing Detergents	This category includes all detergents intended for use in automatic domestic dishwashers and all detergents intended for use in automatic dishwashers operated by professional users but similar to automatic domestic dishwashers in terms of machine size and usage. This category also includes all liquid hand dishwashing detergents for household use, the main function of which is washing up by hand.
Good Environmental Choice Australia	Hand Dishwashing Detergents	This category includes all liquid hand dishwashing detergents for the retail trade or for professional use, the main function of which is washing up by hand. Products with the purpose of disinfecting or limiting growth of micro-organisms (e.g. bacteria) are not included in this product category.
Green Seal (USA)	No separate criteria but DD are covered under Speciality Cleaning Products for Household Use (GS-52)	Hand dish cleaning product. A product labelled and intended for manual washing of dishes, utensils, pots, pans, glasses, cups and other food service tools.
	No separate criteria but IIDD are covered under the Speciality Cleaning Products for Industrial and Institutional Use Category (GS-53)	Hand dish cleaning product. A product labelled and intended for manual washing of dishes, utensils, pots, pans, glasses, cups and other food service tools.
Philippines Green Choice	Liquid dishwashing	These criteria are applicable to liquid dishwashing.
Hong Kong Green Label Scheme	Hand dishwashing detergents	The criteria apply to all hand-wash dishwashing detergents. Rinsing agents are not covered in this document.
Chinese Taipei Green Mark	Dishwashing detergents	This standard is applicable to synthetic cleaning agents ('product') used for kitchenware cleaning and meet the definitions of CNS 3800.

The most relevant ecolabel schemes in terms of HDD use are the EU Ecolabel for HDDs, the Nordic Swan for HDDs, New Zealand's Environmental Choice for HDDs and Sweden's Good Environmental Choice for chemical products. These schemes have been selected above others because of their completeness in the household HDD category.

[40] Ecocert is a certification body that developed standards as a partnership between ECOCERT Greenlife, a certification body in the environmental field, and certain detergent professionals who have long expressed the need to find a solution to the following problems http://www.ecocert.com/sites/default/files/u3/Natural-Detergents-made-with-Organic-Ecocert-Greenlife-11.05.2012.pdf

Additionally, the AISE Charter for Sustainable Cleaning for household manual dishwashing detergents has also been investigated, as the charter consists in criteria that are addressing the same hotspots that the above-mentioned ecolabel schemes.
In the following section (see Table 6) the criteria of these schemes are compared. This review highlights the different approaches taken to ecolabelling and the level of detail employed by different schemes. The excluded substances for different ecolabels are compared in Table 8. Please note that for ease of comparison, some details of environmental criteria for HDDs have been excluded.

The EU Ecolabel and the AISE Charter have the least restrictive guidelines in terms of the limited substances that are permissible in a certified product, with the Nordic Swan, New Zealand Environmental Choice and Sweden's Good Environmental Choice all providing extensive lists. However, it should be noted that in the EU Ecolabel some of these substances are limited by other umbrella legislation, such as the EU Ecolabel Regulation and its Article 6.6 on the limit of use of hazardous substances. Sweden's Good Environmental Choice scheme also provides good detail on the use of surfactants, and all describe clear user instruction requirements. Environmentally hazardous substances and toxicity to aquatic environments are considered in detail in all schemes with the exemption of the AISE Charter. Clear guidance on packaging and consumer information is provided by all schemes, with the New Zealand Environmental Choice label placing the most restrictions on applicant products. This scheme also provides good detail on the requirements for waste management, energy management and product claims, which are largely lacking from the other schemes' criteria. The criteria from the Austrian Ecolabel and the Czech Ecolabel have been excluded from this table as they have been harmonised with the EU Ecolabel criteria. The Australian Good Environmental Choice programs product category for HDDs is no longer open for new applicants; instead HDD are now covered under the 'cleaning products' category.

No ecolabels were identified which have separate criteria for professional and domestic HDDs. In some cases one criteria document covers both automatic and hand dishwashing detergents, for example the Green Mark programme and the Singapore Green labelling scheme. In the Green Seal labelling scheme HDDs are included as part of a large product group named 'speciality cleaning product's. The criteria for both of these ecolabels have been excluded from the detailed review in the table below as they are not very relevant for hand dishwashing and do not provide a good comparison for the EU Ecolabel.

Table 7: Overview of the requirements of different ecolabels for HDDs for consumer use

EU Ecolabel (hand dishwashing detergents)	Nordic Swan (hand dishwashing detergents)	Environmental Choice New Zealand (hand dishwashing detergents)	Bra Miljöval (Good Environmental Choice) (chemical products)
Limited substances			
Fragrances: Any substances added to the product as a fragrance must have been manufactured and/or handled in accordance with the code of practice of the International Fragrance Association. **Biocides:** the product may only include biocides in order to preserve the product, and in the appropriate dosage for this purpose alone. This does not refer to surfactants which may also have biocidal properties. It is prohibited to claim on the packaging or by any other communication that the product has an antimicrobial action.	**Fragrances:** if fragrance is used this must be done in accordance with IFRA guidelines. The following substances must not be included in the product at levels >100 ppm (0.010 %) per substance: • 26 fragrance substances encompassed by the declaration requirement in the Detergents Regulation 648/2004/EEC and its subsequent amendments • Fragrances classified as H317 (R43) or H334 (R42) **Preservatives:** must not be bioaccumulating. The requirement applies to all preservatives in product ingredients and raw materials. **Colorants:** must not be bioaccumulating (logK_{ow} < 4.0 or BCF < 500). **Prohibited substances:** The product must not contain the following substances. • alkylphenol ethoxylate (APEO) or its derivatives • alkylphenol derivatives (APDs) • ethylenediaminetetraacetic acid (EDTA) and its salts • Quaternary ammonium salts that are not readily biodegradable • Methyldibromoglutaronitrile (MG) • Nitromusks and polycyclic musks • Substances with potential for endocrine disruption of Category 1 or 2 in accordance with official EU lists.	**Fragrances:** Fragrances must be produced and used in accordance with the code of practice compiled by IFRA. **Biocides and preservatives:** The product may only include biocides in order to preserve the product, and in the appropriate dosage for this purpose alone. This criterion does not apply to ingredients (e.g.: quaternary ammonium salts) added for other functions but which may also have biocidal properties. **Colorants:** Colouring agents may be added to liquid products only, provided they have been approved a food additive or are not bioaccumulative. The colouring agent is not considered to be bioaccumulative if the BCF <100 or if Log K_{OW} < 3.0. Where there is information on both BCF and Log K_{OW}, the values for BCF must be used. **Banned substances:** The product shall not be formulated or manufactured with the following compounds or substances: • ethylenedinitrilotetraacetic acid or EDTA or any of its salts • nitrilotriacetic acid or any of its salts (NTA) • diethylenetriaminepentaacetic acid (DTPA) or any of its salts • alkylphenol ethoxylates (APEOs) or their derivatives • reactive chlorine compounds such as	**Fragrances**: No more than 0.5 % by weight fragrance content is permitted in the product. This limit also applies to concentrated products that are diluted before use. C**olouring agents** are not permitted. **Phosphorous:** Ingredients that contain phosphorous must not be added to the product intentionally. **Nitrogen:** The nitrogen content of the product must not exceed 1.0 % by weight. **Complexing agents:** Organic complexing agents must be readily biodegradable. **Solvents:** Solvents must be readily biodegradable Solvents, preservatives, thickening agents/dissolving agents, bleaching agents must have a bioconcentration factor (BCF) of less than 100, or log K_{OW} < 3. **Thickening agents** that are completely biodegradable according to OECD 302, may be included up to a maximum concentration of 0.5 % by weight. **Enzymes** are approved in products that bear the Good Environmental Choice label.

	• Substances that have been evaluated in the EU to be PBT (Persistent, bioaccumulable and toxic) or vPvB (very persistent and very bioaccumulable) in accordance with Annex XIII of REACH. Substances of very high concern listed on the candidate list. **Allergenic substances:** The product must not contain ≥ 0.10 % by weight per substance of substances that are classified as H334/R42 and/or H317/R43 according to Regulation (EC) No 1272/2008 or Directive 67/548/EEC.	sodium hypochlorite or organic compounds of chlorine • quaternary ammonium salts that are not readily biodegradable • phosphates. **Heavy metals:** HDDs shall not be formulated or manufactured with compounds or substances that contain toxic metals, including arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), or mercury (Hg). **Enzymes:** The enzyme production micro-organism shall be absent from the final enzyme preparation. In other products, enzymes must be present in liquid form or as a dust-free granulate. **Palm oil and palm kernel oil:** the licence applicant must have an effective purchasing policy for all palm oil, palm kernel oil (or derivatives) or raw materials that are manufactured from palm kernel oil to maximise the use of palm oil and palm kernel oil from sustainable sources.	**Fillers** must meet the requirements for other additives. **Water content** must not exceed 75 % by weight. No requirement is set for water content for products that are sold in spray dispensers.
EU Ecolabel (hand dishwashing detergents)	**Nordic Swan (hand dishwashing detergents)**	**Environmental Choice New Zealand (hand dishwashing detergents)**	**Bra Miljöval (Good Environmental Choice) (chemical products)**
Toxicity to aquatic life			
The critical dilution volume ($CDV_{chronic}$) of the product shall be calculated on the basis of the dosage in grams of the product recommended by the manufacturer for preparing 1 litre of dishwashing water for cleaning of normally soiled dishes. The $CDV_{chronic}$ of the recommended dose expressed for 1 litre of dishwashing water shall not exceed 3 800 litres.	The products CDV is calculated at a dose of 0.60 g/l in-use solution if the specified dosage is ≥ 0,60 g/l. If the recommended dosage is greater than 0.60 g/l, the recommended dosage shall be used for calculations. The product's CDV must not exceed 2500 litres for either $CDV_{chronic}$ or CDV_{acute}.	Any raw ingredient that is classified as 9.1A (aquatic ecotoxin) must be readily biodegradable and not potentially bio-accumulative.	The toxicity of chemical substances to aquatic organisms must be specified, giving results for fish, daphnia and algae (except for preservatives for which data is only required for fish and daphnia). Complexing agents must not be very toxic to aquatic organisms (LC50, EC50 and IC50 > 1 mg/L).

			Solvents must not be toxic to aquatic organisms (LC50, EC50 and IC50 > 10 mg/L). Included solvents must not be harmful to aquatic organisms (LC50, EC50 andIC50 > 100 mg/L). Preservatives must not be very toxic to aquatic organisms (LC50 and EC50 > 1 mg/L). Thickening agents/dissolving agents must not be toxic to aquatic organisms (LC50, EC50 and IC50 > 10 mg/L). Bleaching agents must not be very toxic to aquatic organisms (LC50, EC50 and IC50 > 1 mg/L). Acids must not be toxic to aquatic organisms (LC50, EC50 and IC50 > 10 mg/L).

EU Ecolabel (hand dishwashing detergents)	**Nordic Swan (hand dishwashing detergents)**	**Environmental Choice New Zealand (hand dishwashing detergents)**	**Bra Miljöval (Good Environmental Choice) (chemical products)**
Biodegradability of surfactants			
Each surfactant used in the product shall be readily biodegradable. Surfactants that are not biodegradable under anaerobic conditions may be used in the product provided that the surfactants are not classified with H400/R50 (Very toxic to aquatic life) and that the total weight of such anaerobically non-biodegradable surfactants do not exceed 0.20 g of the recommended dose expressed for 1 litre of dishwashing water.	All surfactants must be aerobically and anaerobically biodegradable.	All surfactants must be readily biodegradable and anaerobically degradable.	Surfactants must be readily biodegradable. Surfactants must be 60 % anaerobically biodegradable. Surfactants must have a very low residual content of organohalogen compounds (<100 mg/kg TOX). Surfactants must not be very toxic to aquatic organisms. Surfactants must not be classified as R50, very toxic to aquatic organisms.

			If palm oil is used as a raw material in surfactant production, the surfactant manufacturer or the palm oil supplier must be a member of the Roundtable on Sustainable Palm Oil (RSPO) or be able to show that the palm oil used to produce the surfactants comes from a plantation that is certified in accordance with RSPO's sustainable cultivation rules.
Information on the recommended dosage shall appear on the packaging in a reasonably sufficient size and against a visible back-ground. The information shall be provided in ml (and tea spoons) of product for 5 l of dishwashing water suitable for 'dirty' and 'less dirty' dishes.	Regarding consumer products, the dosage shall be given as X millilitres per Y litres of water, or as Z teaspoons* per Y litres of water. *1 teaspoon = 5 ml	The product must have information on the recommended dosage on the primary packaging. The dosage must be quoted in whole millilitres for 5 litres of dishwashing water.	The dosage for consumer products must be stated in l, dl, ml or other measurement units. Where the dosage cannot be given in units, a phrase of the type *"try not to use more than needed"* should be printed on the packaging. There are no other specific requirements for HDDs.

<table>
<tr><th>EU Ecolabel (hand dishwashing detergents)</th><th>Nordic Swan (hand dishwashing detergents)</th><th>Environmental Choice New Zealand (hand dishwashing detergents)</th><th>Bra Miljöval (Good Environmental Choice) (chemical products)</th></tr>
<tr><td colspan="4">Limited and excluded substances</td></tr>
<tr>
<td>The product or any part of it thereof shall not contain substances or mixtures meeting the classification with the hazard class or categories listed below:
<table>
<tr><th>GHS Haz statemt</th><th>EU Risk Phrase</th></tr>
<tr><td>H300</td><td>R28</td></tr>
<tr><td>H301</td><td>R25</td></tr>
<tr><td>H304</td><td>R65</td></tr>
<tr><td>H310</td><td>R27</td></tr>
<tr><td>H311</td><td>R24</td></tr>
<tr><td>H330</td><td>R23; R26</td></tr>
<tr><td>H331</td><td>R23</td></tr>
<tr><td>H340</td><td>R46</td></tr>
<tr><td>H341</td><td>R68</td></tr>
<tr><td>H350</td><td>R45</td></tr>
<tr><td>H350i</td><td>R49</td></tr>
<tr><td>H351</td><td>R40</td></tr>
<tr><td>H360F</td><td>R60</td></tr>
</table>
</td>
<td>Products must not be classified according to the classifications listed below:
<table>
<tr><th>Classi-fication</th><th>Hazard statemt (CLP Reg)</th><th>EU Risk Phrase</th></tr>
<tr><td>Hazard-ous to the aquatic environ-ment</td><td>H400
H410
H411
H412
H413</td><td>N with R50 R50/53. R52, R53 or R52/53 without N.</td></tr>
<tr><td>Very toxic</td><td>H300
H310
H330
H370</td><td>Tx with R26, R27, R28 and/or R39.</td></tr>
<tr><td>Toxic</td><td>H330
H331
H311
and/or
H301</td><td>T with R23, R24, R25, R39 and/or R48</td></tr>
</table>
</td>
<td>Hand dishwashing detergents shall not be formulated or manufactured with substances that are classified as:

Category 1 or Category 2 under the EC priority list developed under the Community strategy for endocrine disruptors
Under Hazardous Substances and New Organisms Act (HSNO) as: Class 1 (explosive), Class 3 (flammable), Class 5 (oxidising), 6.5 (sensitisers), 6.6 (mutagenic), 6.7 (carcinogens), 6.8 (reproductive/developmental toxins), 6.9A (systemic toxicants), 8.2 (skin corrosive), 9.1A or 9.1B (aquatic ecotoxins).

</td>
<td>Ingredients or their known breakdown products must not be classified as:
<table>
<tr><th>Classification</th><th>EU Risk Phrase</th></tr>
<tr><td>Carcinogenic</td><td>R45, R49, R40</td></tr>
<tr><td>Mutagenic</td><td>R46, R68</td></tr>
<tr><td>Toxic for reproduction</td><td>R60, R61, R62, R63, R64</td></tr>
</table>
Products must not be classified as:
<table>
<tr><th>Classification</th><th>EU Risk Phrase</th></tr>
<tr><td>Toxic</td><td>R48, R33</td></tr>
<tr><td>Sensitising</td><td>R42, R43</td></tr>
<tr><td>Very toxic</td><td>R26, R27, R28, R23, R24, R25, R39</td></tr>
<tr><td>Irritant</td><td>R35</td></tr>
</table>
</td>
</tr>
</table>

H360D	R61
H360FD	R60-61
H360Fd	R60-63
H360Df	R61-62
H361f	R62
H361d	R63
H361fd	R62-63
H362	R64
H370	R39/23; R39/24; R39/25; R39/26; R39/27; R39/28
H371	R68/20; R68/21; R68/22
H372	R48/25; R48/24; R48/23
H373	R48/20; R48/21; R48/22
H400	R50
H410	R50-53
H411	R51-53
H412	R52-53
H413	R53
EUH059	R59
EUH029	R29
EUH031	R31
EUH032	R32
EUH070	R39-41
H334	R42
H317	R43

Derogations: the following substances or mixtures are specifically exempted from this requirement:

Substance /mixture	**GHS Haz st'mt**	**EU Risk Phrase**
Surfactants in concs <25 % in the product	H400	R50
Fragrances	H412	R52-53
Enzymes	H334	R42
Enzymes	H317	R43
NTA as an	H351	R40

Aspir-ation hazard	H304	Xn with R20, R21, R22, R48, R65 and/or R68
Sensi-tising	H334 H317	Xn with R42 or Xi with R43
Carcino-genic	H350, H350i H351	Carc with R45, R49, R40.
Muta-genic	H340 H341	R46 R68
Toxic for repro-duction	H360F H360D H361f H361d H362	Repr. With R60, R61, R62, R63, R64.

Substances in the product must not be classified according to the classifications in the table below:

Classifi-cation	**Haz st'mt (CLP Reg)**	**EU Risk Phrase**
Carcino-genic	H350 H350i H351	Carc. with R45, R49, R40
Muta-genic	H340 H341	Muta. with R46, R68
Toxic for repro-duction	H360F H360D H361f H361d H362	Repr. with R60, R61, R62, R63, R64

impurity in MGDA and GLDA						

EU Ecolabel (hand dishwashing detergents)	Nordic Swan (hand dishwashing detergents)	Environmental Choice New Zealand (hand dishwashing detergents)	Bra Miljöval (Good Environmental Choice) (chemical products)
Packaging			
Plastics that are used for the main container shall be marked in accordance with Directive 94/62/EC or DIN 6120 part 1 and 2 in connection with DIN 7728 part 1. If the primary packaging is made of recycled material, any indication of this on the packaging shall be in conformity with ISO 14021. Only phthalates that at the time of application have been risk assessed and have not been classified according to criterion 3(c) may be used in the plastic packaging. The weight utility ratio (WUR) of the primary packaging must not exceed 1.20 g packaging /l use solution (dish-washing water).	**Plastic packaging** (including caps, lids and pumps) and labels containing PVC or plastic based on other types of chlorinated materials must not be used. To facilitate identification for recycling, plastic bottles that are used as packaging must be marked in accordance with DIN 6120, section 2, ISO 11469:2000 or equivalent standard. Caps, lids and pumps are exempt from this requirement. The products **weight-to-benefit ratio** (WUR) is calculated as follows: **$WUR = \Sigma [(W_i + N_i)/(D_i * t_i)] < 0.15$** W_i = Weight of the primary packaging component (i) in grams including cap, dispenser or similar. N_i = weight (g) of non-recycled (virgin) material in packaging component (i) in gram. If the proportion of recycled material in the packaging component is 0 %, Ni = Wi. D_i = Number of doses in the primary packaging component (i). t_i = Reuse factor. I.e. the number of times that the packaging component (i) is reused. t = 1 if the packaging is not reused for the	All plastic packaging must be made of plastics that are able to be recycled in the country where the product is sold. Primary packaging must not be impregnated, labelled, coated or otherwise treated in a manner, which would prevent recycling (i.e. PVC sleeves, metallic labels). Primary cardboard packaging shall consist of 80 % recycled content, 25 % of which must be post-consumer material The primary packaging, shall have a weight utility ratio (WUR) of less than or equal to 1.2 g/l. The WUR is calculated for the primary packaging (including caps, stoppers bottles and hand pumps/ spraying devices) using the following formula. WUR = weight of primary packaging/number of doses recommended for 1 litre of washing water. Information shall be provided to The Trust at application and thereafter reported annually on PVC and/or phthalates used in the packaging. This should include information from production records and/or suppliers on: • the percentages by weight of recycled	Packaging must be made of components that are easy to take apart, and each component must consist of a single type of material. Refill packaging that weighs no more than 30 % of the weight of the original packaging is exempted from this rule. Plastic packaging must be made from polyethylene (PE), polypropylene (PP), poly-ethylene terephthalate (PET) or an equivalent plastic. PVC is not permitted. Plastic packaging must be marked in accordance with DIN 6120 or American SPI. It is not necessary to mark small parts, such as stoppers, in this way. At least 80 % of cardboard packaging must be manufactured from wood fibre obtained from recycled raw material. If new raw material is used for the rest of the card-board, at least 30 % of this must be certified by FSC. If the product content prevents the use of recycled raw materials for packaging, it is acceptable to use cardboard that is 100 % FSC-certified. Only wholly chlorine-free bleaching methods may be used. As far as possible, the pack-aging must comply with REPA's recommendations to facilitate recycling. Products that are intended for sale to consumers must carry instructions on how the packaging should be sorted for recycling in accordance with the document

	same function (disposable packaging). t > 1 may only be used if supported by documentation demonstrating that the packaging is reused for the same function. **Take-back system:** national regulations, legislation and/or agreements within the sector regarding the recycling systems for products and packaging shall be met in the Nordic countries in which the company markets its dishwasher detergents.	and virgin PVC • the particular production processes (membrane cells, non-asbestos diaphragms, modified diaphragms, graphite anodes, mercury cells, closed-lid production etc.) used to produce chlorine and VCM for the PVC being used in the packaging for ECNZ-licensed products (including the locations of the production) • information, where available, on waste disposal, wastewater treatment and emissions to air (occupational exposure, emissions from the factory and from the final PVC resin) • information on any Environmental Management System (EMS) for the production process, including requirements for waste, water, air and product-related requirements • the types of stabilisers used • the types and amounts of any phthalate plasticisers present in recycled content of the PVC (if that information is available) and/or added when manufacturing PVC • research and initiatives implemented on substitutes for phthalates identified as of concern by regulators • any product stewardship arrangements for the packaging.	'REPA's instructions'. If the packaging consists of different materials, information must also be given on how the different components should be recycled. No metal may be used in the packaging. Exceptions to this requirement may be allowed for large packaging that can be recycled. Metal may be used in the handles of buckets that hold 15 litres or more if the handle can easily be removed when the packaging is recycled. Nozzles on packaging such as pump bottles and trigger sprays are exempted from this requirement.

EU Ecolabel (hand dishwashing detergents)	**Nordic Swan (hand dishwashing detergents)**	**Environmental Choice New Zealand (hand dishwashing detergents)**	**Bra Miljöval (Good Environmental Choice) (chemical products)**
Consumer information			
The product shall bear the following information on the packaging: • *"Do not use running water but immerse the dishes, and use the recommended dosage"* (or		The HDDs shall be accompanied by instructions for proper use so as to maximise product performance and minimise waste. These instructions shall	

equivalent text) • Information on the recommended dosage shall appear on the packaging in a reasonably sufficient size and against a visible background. The information shall be provided in millilitres (and tea spoons) of product for 5 litres of dishwashing water suitable for 'dirty' and 'less dirty' dishes • An indication of the approximate number of washes that the consumer can perform with one bottle is recommended but voluntary.		include information on reuse, recycling and/or correct disposal of packaging. The product must have information on the recommended dosage on the primary packaging. The dosage must be quoted in whole ml for 5 l of dishwashing water. • A second well-known metric, such as teaspoons, shall additionally be given in brackets. However, if the packaging has an efficient and convenient dosing system that can provide an equally reliable dosage, an alternative metric (e.g. capfuls, squirts, or other) can be used. • The dosing instructions may be stated for various water hardnesses and for various levels of soiling or for various levels of washing up. All HDDs must display on the container a list of product ingredients that complies with the labelling requirements of Article 11 of Reg (EC) No. 648/2004 of the European Parliament and of the Council of 31 March 2004 on Detergents, as amended by Reg (EC) No 907/2006 of 20 June 2006. The following or equivalent words should be clearly displayed on the packaging. "*All detergents have an effect on the environment. Always use the correct dose for maximum efficiency and minimum environmental impact.*" Any proposed changes/ alterations to this wording must be submitted to and approved by The Trust.	

		All labelling shall comply with the requirements of HSNO legislation or the appropriate hazardous substance legislation for the country where the product is sold. All packaging shall include a website reference where a copy of the product data sheet can be obtained.	
The product shall be fit for use, meeting the needs of the consumers. The cleaning ability and the cleaning capacity must be equivalent to or better than that of the generic reference detergent specified below. Assessment and verification: the cleaning ability and cleaning capacity must be tested by means of an adequate and justifiable laboratory performance test carried out and reported within specified parameters as stated in the framework that can be found here: http://ec.europa.eu/environment/ecolabel/ecolabelled_products/categories/hand_dishwashing_detergents_en.htm The generic reference detergent shall be the one prescribed in the IKW performance test 'Recommendation for the quality assessment of the cleaning performance of hand dishwashing detergents'(SÖFW-Journal, 128, 5, pp. 11-15, 2002) with the adaptation that the dosage applied in the performance test is set at 2,5 millilitres of the reference detergent per 5 litres of water. The IKW performance test 'Recommendation for the quality assessment of the cleaning performance of HDDs' (SÖFW-Journal, 128, 5, pp. 11-15, 2002) method may be applied with the mentioned adaptation and can be downloaded from:	The performance test shall be conducted by a laboratory within the framework specified by Appendix 5. The test results shall be documented in accordance with Appendix 5. The test shall be performed by a laboratory complying with Appendix 2. • The reference product is tested at the lowest recommended dosage that is stated on the packaging. If no dosage instructions are provided, the same dosage is used as for the test product. • The test product is tested at the lowest recommended dosage. • The reference product is defined as one of the well-established (3-4 market-leading) HDDs in a Nordic country or the Nordic region. • The reference product shall be different from the product to be ecolabelled. The reference product must come from a different manufacturer than that of the product to be ecolabelled. • The reference product must be purchased in connection with the performance of the test. • The product shall be tested against another consumer product. If the product is marketed for both professional and consumer use it shall	The product shall be fit for its intended use and conform, as appropriate, to relevant product performance standards. Performance of the product with respect to both cleaning ability (ability to remove soil) and cleaning performance (the total amount of soil removed per dish wash) must be assessed.	

http://www.ikw.org/pdf/broschueren/EQ_Handgeschirr_e.pdf	be tested against a professional product.		
		The licence applicant/holder and product manufacturer must have effective waste management policies and procedures and/or a waste management programme. Licence holders must also report annually to The Trust on waste management.	

EU Ecolabel (hand dishwashing detergents)	Nordic Swan (hand dishwashing detergents)	Environmental Choice New Zealand (hand dishwashing detergents)	Bra Miljöval (Good Environmental Choice) (chemical products)
Information appearing in the EU Ecolabel			
		The licence applicant/holder and product manufacturer must have effective energy management policies and procedures and/or an energy management programme. In addition, license holders must report annually to The Trust on energy management.	
Optional label with text box shall contain the following text: • reduced impact on aquatic life • reduced use of hazardous substances • reduced packaging waste • clear user instructions.		No claim or suggestion, on the packaging or by any other means, shall be made that the product has an antimicrobial action. If the licence holder includes claims relating to the product being 'natural' or 'plant based' the licence holder shall provide evidence to support the claim, including but not limited to: • the definition used by the licence holder to support the 'natural' or 'plant based' claim; • the source of all ingredients including whether they are synthetic versions of the chemicals; and • evidence of chain of custody where synthetic versions exist and the ingredients are non-synthetic versions	

The AISE Charter for Sustainable Cleaning (household manual dishwashing detergents) has developed also criteria that aim at promoting the best environmental performance products. These criteria are:
- Limited substances: Product formulation must pass successfully Environmental Safety Check (ESC) on all ingredients.
- Dosage and dosage instructions: Dosage must not exceed 12 ml/job (preparation of 1 litre of wash water)
- Packaging: Total (primary + secondary but excluding tertiary) packaging must be ≤ 1.3 g/job Board packaging – recycled content requirement of ≥ 60 % OR where 100 % of the board used is certified made from fibre sourced from sustainable forests under an endorsed certification standard such as FSC, SFU or PEFC: no minimum.Materials other than board – recycled content: no minimum, but any recycled plastic content may be excluded from the calculation of total packaging weight per job
= Consumer information: End user information on clean right and Safe Use tips must be displayed on pack.
- Performance: Evidence has to be provided (in case of external verification organised by AISE) that the product has been performance tested and reached a level acceptable to consumers consistent with claims made.

Table 8: Comparison of explicitly excluded substances

Substance	EU Ecolabel	Nordic Swan	Environmental Choice NZ	Bra Miljöval (Good Environmental Choice)
APEO and derivatives	X	X	X	
EDTA and salts	X	X	X	
5-bromo-5-nitro-1,3-dioxane	X			
2-bromo-2-nitropropane-1,3-diol	X			
Diazolinidylurea	X			
Formaldehyde	X			
Sodium hydroxyl methyl glycinate	X			
Nitro-musks and polycyclic musks	X	X	X	
Quaternary ammonium salts that are not readily biodegradable	X	X		X
Fragrances		X (not permitted in professional products)		Limitations apply
APD and derivatives		X		
Methyldibromoglutaronitrile (MG)		X		
Substances on EU list of endocrine disruptors		X		
Substances that are PBT or vPvB[41]		X		

Substances of very high concern listed on EU candidate list[41]		X		
Nitrotriacetic acid of any of its salts			X	
Diethylene triamine pentaacetic acid (DTPA)			X	
Reactive chlorine compounds				
Phosphates/phosphorus		Limitations apply	X	X
Heavy metals			X	X
Chlorine containing bleach				Limitations apply
Organically bound halogens				X

Note that this does not take into account other substances which may be excluded by applicable regulations in the region for which they operate.

[41] EU Ecolabel excludes also those substances that fall under these categories but it does not do it explicitly. But by means of the implementation of articles 6.6 and 6.7 of the EU Ecolabel regulation.

2.6 Summary of the findings

Very few formal definitions or scope documents for HDDs have been developed. However, alternative voluntary labelling schemes such as Nordic Swan and Environmental Choice have developed definitions for the HDD product group. These have been considered along with feedback from the stakeholder consultation to help provide recommendations for the scope and definition of the EU Ecolabel HDD product category.

According to the research carried out so far, for the HDD product it is recommended that the product group scope and definition shall remain the same.

*The product group '**hand dishwashing detergents'** shall comprise all detergents which main function is manual washing of dishes, crockery, pots, pans, glasses, cups, kitchen utensils and other food service tools.*

The product group shall cover products for both private and professional use. The products shall be a mixture of chemical substances and must not contain microorganisms that have been deliberately added by the manufacturer.

However, this definition can be subject of changes if further information is received during the revision process.

Indeed the restriction of substances containing microorganism should be further investigated.

MARKET ANALYSIS

2.7 Introduction

In order to characterise the relevant European market for the product group under study, a market analysis has been conducted. The objective of the market analysis is to identify significant changes in the market for HDDs since the last development of the EU Ecolabel criteria and investigate whether any such changes need to be reflected in the criteria so that the 10-20 % best environmentally performing products will be selected in accordance with Annex 1 of the EU Ecolabel Regulation.

The research in this section consists of a desktop study using a variety of available literature and statistical databases, such as: EUROSTAT, Datamonitor, Mintel and Euromonitor data and reports. The market analysis covers the period 2010-14 and includes a market forecast to 2015-16.

2.7.1 Economic indicators

Analysis of PRODCOM data categories compared with the current EU Ecolabel criteria definition and scope indicates that the classifications are irreconcilable. The PRODCOM 'cleaning product' categories are not broken down in such a way that could be useful for analysis of current EU Ecolabel HDD criteria (see Table 9).

Table 9: PRODCOM cleaning product categories, code and description

Code(s)	Description
20.20.14.30	Disinfectants based on quaternary ammonium salts put up in forms or packing for retail sale or as preparations or articles
20.20.14.50	Disinfectants based on halogenated compounds put up in forms or packing for retail sale or as preparations
20.20.14.90	Disinfectants put up in forms or packing for retail sale or as preparations or articles (excluding those based on quaternary ammonium salts, those based on halogenated compounds)
20.41.20.20	Anionic surface-active agents (excluding soap)
20.41.20.30	Cationic surface-active agents (excluding soap)
20.41.20.50	Non-ionic surface-active agents (excluding soap)
20.41.20.90	Organic surface-active agents (excluding soap, anionic, cationic, non-ionic)
20.41.31.20	Soap and organic surface-active products in bars, etc, n.e.c.
20.41.31.50	Soap in the form of flakes, wafers, granules or powders
20.41.31.80	Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders
20.41.32.40	Surface-active preparations, whether or not containing soap, p.r.s. (excluding those for use as soap)
20.41.32.50	Washing preparations and cleaning preparations, with or without soap, p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations
20.41.32.60	Surface-active preparations, whether or not containing soap, n.p.r.s. (excluding those for use as soap)
20.41.32.70	Washing preparations and cleaning preparations, with or without soap, n.p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations

Source: Eurostat PRODCOM

*not elsewhere classified (n.e.c.) ** packaged for retail sale (p.r.s.) *** not packaged for retail sale (n.p.r.s.)

Furthermore, the composition of the various 'cleaning product' categories is not clearly outlined, and therefore it is not possible to break these down to the category of 'dishwashing detergent', to provide data which are wholly applicable to the requirements of EU Ecolabel. Table 10 shows a comparison of the categorisation.

Table 10: Comparison of the categorisation criteria for PRODCOM and EU Ecolabel for HDD

PRODCOM categories (cleaning product *type*)	EU Ecolabel for HDD product classification (cleaning product *application*)
• Disinfectants based on quaternary ammonium salts put up in forms or packing's for retail sale or as preparations or articles • Disinfectants based on halogenated compounds put up in forms or packings for retail sale or as preparations • Disinfectants put up in forms or packings for retail sale or as preparations or articles (excluding those based on quaternary ammonium salts, those based on halogenated compounds) • Anionic surface-active agents (excluding soap) • Cationic surface-active agents (excluding soap) • Non-ionic surface-active agents (excluding soap) • Organic surface-active agents (excluding soap, anionic, cationic, non-ionic) • Soap and organic surface-active products in bars, etc., n.e.c. • Soap in the form of flakes, wafers, granules or powders • Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders • Surface-active preparations, whether or not containing soap, p.r.s. (excluding those for use as soap) • Washing preparations and cleaning preparations, with or without soap, p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations • Surface-active preparations, whether or not containing soap, n.p.r.s. (excluding those for use as soap) • Washing preparations and cleaning preparations, with or without soap, n.p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations.	The product group comprises: • All detergents intended to be used to wash by hand dishes, crockery, cutlery, pots, pans, kitchen utensils etc.

EUROSTAT data (PRODCOM) will therefore be used only to provide cumulative data on the overall cleaning products market in Europe (including dishwashing, soaps and other washing and cleaning preparations), broken down by Member State. This analysis will include all HDDs, but will not allow for specific analysis of this product category.

2.7.1.1 Trade and production data, cleaning products market

The table below provides the PRODCOM production data (value and volume) for all cleaning products in 2013, including dishwashing, soaps and other washing and cleaning preparations. The total EU-28 production in 2013 of cleaning products was €19 billion with 17 million tonnes produced. Germany has the highest production value (€5 billion) and the Italy the highest production volume (3.004 million tonnes). NB countries marked with an asterisk exclude some data which is anonymous. Figures may therefore be higher than indicated in Table 11.

Table 11: Production of manufactured cleaning products in EU-28, value and tonnes, 2013

EU-28	Value (€m)	Sold volume (tonnes)	EU-28	Value (€m)	Sold volume (tonnes)
Austria*	372,619	421,327	**Italy**	2,673,495	3,003,591
Belgium*	547,217	557,297	**Latvia***	0	0
Bulgaria*	63,052	74,552	**Lithuania**	10,116	12,507
Croatia	102,119	116,239	**Luxemburg**	0	0
Cyprus	0	0	**Malta**	0	0
Czech Republic*	110,486	123,683	**Poland***	816,017	923,134
Denmark	205,600	167,633	**Portugal***	149,367	246,307

EU-28	Value (€m)	Sold volume (tonnes)	EU-28	Value (€m)	Sold volume (tonnes)
Estonia	17,229	24,074	**Romania***	159,284	233,224
Finland	41,481	22,225	**Slovakia***	5,656	6,608
France	872,608	1,656,392	**Slovenia**	5,719	4,732
Germany*	4,601,831	3,232,793	**Spain**	2,168,032	2,413,072
Greece*	117,792	91,311	**Sweden**	57,148	35,372
Hungary	228,066	230,961	**The Netherlands**	36,625	21,202
Ireland	18,784	20,474	**UK**	1,953,162	1,438,265
			EU-28	**19,265,686**	**16,592,287**

* Estimates only – excludes some data which is anonymous. 'Value EU27' includes all data.
Source: PRODCOM

In the same way that PRODCOM data is irreconcilable with current EU Ecolabel definitions for HDDs, COMEXT[42] data (international trade data) also consists of different categories which do not correspond to the EU Ecolabel HDD product category. Table 12 shows the COMEXT codes and descriptions for categories which include detergents. Neither do these directly relate to the PRODCOM categories indicated above. Even so, these data can be used to give an overall indication of both intra- and extra-EU trade for cleaning products.[43]

Table 12: COMEXT detergent code and description

Product code	Description
34012090	Soap in paste form 'soft soap' or in aqueous solution 'liquid soap'
34012010	Soap in the form of flakes, granules or powders
34011100	Soap and organic surface-active products and preparations, in the form of bars, cakes, moulded pieces or shapes, and paper, wadding, felt and nonwovens, impregnated, coated or covered with soap or detergent, for toilet use, incl. medicated products
34011900	Soap and organic surface-active products and preparations, in the form of bars, cakes, moulded pieces or shapes, and paper, wadding, felt and nonwovens, impregnated, coated or covered with soap or detergent (excl. those for toilet use, incl. medicated products)

Table 13 shows the value and volume of intra-EU trade of cleaning products for 2013. Overall, this totals:

- imports of 623,793 tonnes (€1,090 million)
- exports of 690,659 tonnes (€1,150 million).

Table 13: Intra-EU trade of cleaning products, import and exports, 2013

	Imports		Exports	
EU-28	**Value (million euros)**	**Quantity (100kg)**	**Value (million euros)**	**Quantity (100kg)**
Austria*	43	194,848	8	17,343
Belgium*	71	348,454	65	400,996
Bulgaria*	9	42,852	4	29,439
Croatia	8	47,416	0	692
Cyprus	3	14,960	0	633
Czech Republic*	32	178,434	26	146,934
Denmark	21	139,862	16	79,277
Estonia	4	14,542	1	2,248
Finland	21	80,538	1	2,107
France	167	966,219	66	274,158
Germany*	133	758,634	304	1,899,952

[42] COMEXT = statistical database on trade of goods managed by Eurostat.
[43] Intra-EU trade refers to the trade between the Member States of the European Union, while Extra-EU trade refers to the trade between Member States and partner countries that are not members of the European Union.

	Imports		Exports	
EU-28	**Value (million euros)**	**Quantity (100kg)**	**Value (million euros)**	**Quantity (100kg)**
Greece*	17	94,548	9	49,206
Hungary	28	168,663	10	43,066
Ireland	54	211,946	8	24,810
Italy	49	299,228	205	1,377,243
Latvia*	5	23,092	1	3,753
Lithuania	6	29,207	2	8,094
Luxemburg	7	23,359	1	4,391
Malta	2	9,415	0	0
The Netherlands	72	420,593	77	362,389
Poland*	56	385,558	120	805,672
Portugal*	49	382,657	9	41,269
Romania*	24	158,425	3	12,126
Slovakia*	13	83,864	4	27,713
Slovenia	10	49,120	4	14,808
Spain	52	323,535	47	340,615
Sweden	33	195,601	24	132,164
UK	100	592,369	136	765,500
EU-28	**1,090**	**6,237,939**	**1.150**	**6,906,598**

Source: COMEXT trade data; see Annex II for original data

Table 14 shows the value and volume of extra-EU trade of cleaning products for 2013. Overall, this totals:

- imports of 215,796 tonnes (€302 million)
- exports of 219,224 tonnes (€487 million).

Table 14: Extra-EU trade of cleaning products, imports and exports, 2013

	Imports		Exports	
EU-28	**Value (million euros)**	**Quantity (100kg)**	**Value (million euros)**	**Quantity (100kg)**
Austria*	6	25,106	2	6,326
Belgium*	22	157,013	7	20,365
Bulgaria*	10	100,764	4	29,543
Croatia	2	15,546	2	8,804
Cyprus	1	3,805	0	126
Czech Republic*	9	66,150	6	30,143
Denmark	4	22,912	11	42,636
Estonia	0	1,835	0	858
Finland	0	1,166	1	3,434
France	32	276,851	52	153,958
Germany*	44	350,637	117	587,966
Greece*	2	17,530	2	12,174
Hungary	2	13,344	3	17,159
Ireland	0	2,457	0	118
Italy	13	113,920	37	189,006
Latvia*	1	5,787	3	10,013
Lithuania	1	6,756	5	26,754
Luxemburg	0	1	0	1
Malta	0	2,141	0	768
The Netherlands	29	186,073	44	178,489
Poland*	19	141,489	30	140,824
Portugal*	2	19,172	12	97,462
Romania*	9	73,520	3	11,029
Slovakia*	2	11,646	0	1,766

	Imports		Exports	
EU-28	**Value (million euros)**	**Quantity (100kg)**	**Value (million euros)**	**Quantity (100kg)**
Slovenia	1	3,913	2	11,956
Spain	12	82,408	19	108,681
Sweden	5	33,695	20	75,432
UK	73	422,331	104	426,456
EU-28	**302**	**2,157,968**	**487**	**2,192,247**

Source: COMEXT trade data. See Annex II for original data

As seen, there are some countries that play the main roles in all the categories: importers and exporters in both the intra- and extra-EU market. These countries are (order is not considered): Germany, France and UK. They are also three of the mostly populated countries in EU and this fact can be somehow related to their market activity. Table 15 summarises the value of intra- and extra EU-trade. It shows that the majority of both import and export is domestic (i.e. detergents are produced and consumed within the EU boundary). There is, however, a degree of both import and export between the EU and the rest of the world.

Table 15: Summary of intra- and extra-EU trade

	Import value (million euros)	Export value (million euros)
Intra-EU trade	6,237,939	6,906,598
Extra-EU trade	2,157,968	2,192,247

Source: COMEXT trade data.

2.7.1.2 Date sources and split

In place of the PRODCOM and COMEXT data, a number of more relevant sources will be used to better analyse the EU market for HDDs.

EU Market

For Europe as a whole, Euromonitor (Passport) country reports are available for HDD for several European countries, including estimates up to 2018. The countries analysed in this report are the UK, Germany, Italy, France, Poland and Denmark. This data will be used to provide an overall view of the European market for HDDs. Apart from this data, there is no comprehensive dataset for HDDs only, as other data incorporates both hand and automatic dishwashing detergents.

International Association for Soaps, Detergents and Maintenance Products (AISE) data has been used to provide a total figure for the value of the HDD market in Europe. 2013 AISE data puts the total market value of the HDD market at € 1,808 million[44] (EU-27 + Switzerland (CH) + Norway (NO) in 2012).

The sales value of all products for the six countries outlined in the section above is €1,089 million – it can be assumed that these represent 60 % of the European market for HDDs.

Supply chain

The data informing the analysis of the supply chain (including raw materials) is primarily from the 2009 Frost & Sullivan report, '*Strategic analysis of the home and fabric care speciality ingredients market in Europe'.* This report provides an overview of the supply chain of products in the home and fabric care market, which includes specialty surfactants, functional polymers, fabric enhancers, active ingredients and rheology modifiers in home and fabric care as well as hard dishwashing products, surface cleaners, car interior and upholstery cleaners, fabric care, furniture and shoe and leather polishes.

Dishwashing detergents are included in this report, but cannot be further segregated from the information presented. Therefore, this report will be used to provide an overview of the cleaning product market as a whole, but it should not be considered as an overview of the hand dishwasher detergents in Europe.

[44] AISE (2013) *Market and Economic data* [online] Available at: http://www.aise.eu/our-industry/market-and-economic-data.aspx

2.8 Market structure

2.8.1 Global overview, market size

The global market for household products (including household cleaners & bleach products, air fresheners and textile washing products) is valued at an estimated $170 billion (or € 123 billion – 2010 data). Overall, the EU is estimated to account for about 35 % of this market in terms of value – a total of $60 billion (or €45 billion – 2010 data). This market is growing with a growth of more than 19 % between the years of 2006-2011.[45] It is estimated that the global household products market will grow between 2013 and 2016 at a compound annual growth rate (CAGR)[46] of 3.5 %.[47] Current and future global growth rates can be partially explained by a large increase in consumer demand for detergents in the Asia-Pacific region, with growth being predominantly underpinned by China, whose market for household detergents is projected to grow by 6 % per year between 2014 and 2017.[48]

2.8.2 EU overview, market size

As well as HDDs for domestic use, there is a market for Industrial & Institutional (I&I) HDDs. The market values of these sectors in Europe are outlined in Table 16.

Table 16: Market value of dishwashing detergents (EU-27 + CH + NO), 2012

Type of dishwashing detergents	€ million
Hand dishwashing detergents*	€ 1,808
I&I (all kitchen and catering detergents*)	€ 1,518

Source: Euromonitor International, cited on AISE website http://www.aise.eu/our-industry/market-and-economic-data.aspx
products for domestic use only.
** including dishwasher detergents, hand dishwashing detergents, kitchen surface disinfectants, hand hygiene and care for I&I use (non-domestic).

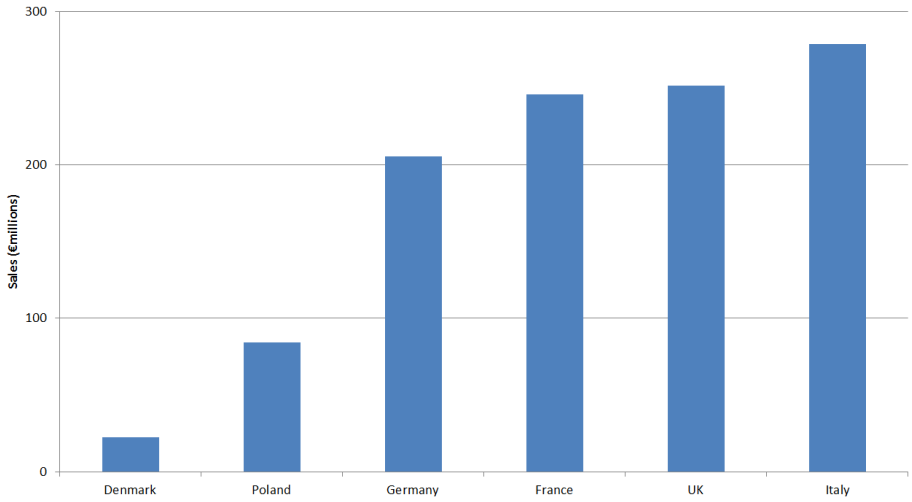
The data for the industrial and institutional market includes a variety of kitchen and catering detergents, but it is unknown what proportion of this relates to HDD only.

2.8.3 EU market structure, national level

Source: Adapted from Passport data, *Market Sizes, Dishwashing (2008-2018)*
Figure 1 shows the sales value of HDDs across six countries from different European regions. Combined, the sales value for these countries represents 60 % of the HDD market in Europe (assuming a total market size of €1,808 million). Importantly, countries across Europe have very different population sizes and GDP. The larger countries with a higher GDP (such as the UK or Germany) will be expected to have higher sales values than those countries with a lower population or GDP (such as Poland or Denmark) – briefly, a larger population and greater GDP per capita will result in higher sales of products and a higher total sales value.

Across these six countries, sales of dishwashing detergents (both hand and automatic detergents) are highest in Italy, followed by the UK and France.

[45] MarketLine Industry Guide (2014) *Household products.* [online] Available at: http://www.reportlinker.com/ci02166/Household-Products.html
[46] compound annual growth rate, the year-over-year growth rate over a specified period of time.
[47] Datamonitor (2014) *Datamonitor's Market Data Analysis*
[48] Chemical Week, Soaps and Detergents: Consumers Remain Cautious, 17 January 2014, available at http://www.chemweek.com/sections/cover_story/Soaps-and-detergents-Consumers-remain-cautious_58079.html



Source: Adapted from Passport data, *Market Sizes, Dishwashing (2008-2018)*

Figure 1: Sales value (€ m) of HDDs in six European countries, 2013

2.8.4 Manufacturers and market share

Both the automatic and hand dishwashing detergents market across Europe (as with the detergents and cleaning market in general) are heavily dominated by a few well-known and globally recognised manufacturers. The top five organisations by retail value across Europe are listed in Table 17. Overall, the top five organisations in the European market for surface care have an estimated 66 % of the market share in 2013. As well as the companies listed below, there are an estimated 92 other organisations (in addition to private label manufacturers) in the dishwashing detergent market, all of which have a market share of 1 % or below.

Table 17: Largest manufacturers in European* DD market, % breakdown by retail value, 2013**

Manufacturers name	% share of dishwashing detergent market, by retail value
Reckitt Benckiser Plc	24 %
Procter & Gamble Co	13 %
Henkel AG & Co KGaA	13 %
Unilever Group	12 %
Colgate-Palmolive Co	4 %
Private label	22 %
Other (circa 92 organisation)	12 %

* EU-28 excluding Cyprus, Estonia and Malta due to lack of data

** Dishwashing detergent includes both hand dishwashing and machine dishwashing detergents.

Source: Euromonitor International, Data used in Passport report, *Brand share by global brand name (2013)*

The structure of the dishwashing detergents market has changed little over the past five years. Market dominance by a small number of large manufacturers is typical, and the manufacturers outlined in Table 17 have historically represented a large portion of the market.

2.8.4.1 Brand data

Table 18 identifies the top 10 dishwashing detergent brands by % brand share. Not only are there a small number of organisations dominating the market, but a small number of brands within these organisations hold the greatest market share. Table 18 includes both hand and automatic dishwashing detergents. Reckitt Benckiser (the top company by brand) is generally considered to be the market leader in the European market for automated dishwashing products, with its product line *Finish*.[49] However, Reckitt Benckiser also produces HDDs. In the HDD market, *Fairy* (Proctor & Gamble) is widely recognised as the brand with the biggest share.

[49] Frost & Sullivan (2009) Strategic analysis of the home and fabric care speciality ingredients market in Europe

Table 18: Dishwashing detergents*, top 10 brands (brand share, %), Europe, 2013**

Brand	Manufacturer	Brand share (%)
Finish	Reckitt Benckiser Plc	22 %
Fairy	Procter & Gamble Co	11 %
Sun	Unilever Group	8 %
Somat	Henkel AG & Co KGaA	6 %
Pril	Henkel AG & Co KGaA	2 %
Svelto	Unilever Group	2 %
Pur	Henkel AG & Co KGaA	2 %
Paic	Colgate-Palmolive Co	2 %
Palmolive	Colgate-Palmolive Co	1 %
Dreft	Procter & Gamble Co	1 %
Private label	-	22 %
Ecover	Ecover Belgium NV	0.8 %

* Dishwashing detergent includes both hand dishwashing and machine dishwashing detergents.
** EU-28 excluding Cyprus, Estonia and Malta due to lack of data

Ecover is the largest 'green' manufacturer of dishwashing detergents, with an estimated 8 % of the market. This ranks as a significant 17th of over 71 brands, and shows a high presence of Ecover products in the European market.

The proportion of private label manufacturers in the dishwashing detergent market is relatively high (22 % of the market by retail value). These manufacturers typically produce for supermarkets that sell own brand products. There are a large number of supermarket brands across Europe, and competition between them is intense. Often supermarket brands compete on a low price basis and sell via discounted prices and offers in store.

2.8.4.2 The industrial and institutional dishwashing detergent market

The global industrial and institutional market for cleaning products is dominated by two major players; together, these companies account for about 24 % of the global market for industrial and institutional cleaning products.[50] These organisations are:

1. **Ecolab** – a US-based global company, providing hygiene and food safety services and products to industrial and hospitality markets.
2. **Diversey** – also US-based, operating globally, providing cleaning and hygiene products to a variety of markets including food service and food and beverage companies.

The remainder of the market is made up of a large number of small local and national companies, each with no more than $50 million in annual industrial and institutional cleaner sales – in many cases much less. However, these smaller companies are beginning to increase their market visibility as a result of recent consolidations.[48] Even so, the market remains fragmented.

Some of the typical household brands also produce industrial products – including Procter & Gamble (P&G) Professional's *Deepio* washing up liquid launched in 2013, which is designed for use on heavily soiled items[51],

[50] IHS(2010) Industrial and Institutional Cleaners
[51] BigHospitality (2013) *P&G Professional launches Deepio washing-up liquid.* [online] Available at: http://www.bighospitality.co.uk/New-Products/P-G-Professional-launches-Deepio-washing-up-liquid

and the *extra tough Fairy* washing up liquid (also P&G) which is designed to help operators save time in the kitchen by reducing soaking times.[52]

The global market for I&I cleaning products is expected to grow at an average annual rate of about 3 % by weight.[48] No specific figures are available for industrial HDDs, although the industrial and institutional market for all kitchen and catering detergents[53] is valued at €1,518 million.[54] If the market for these products increases in line with global expectations for volume growth it will increase by €141 million in the next three years (see Table 19).

Table 19: Expected growth in the I&I market for kitchen and catering detergents (€ m), 2013–16 estimate

	2013	2014	2015	2016
Market value*	€1,518m	€1,564m	€1,610m	€1,659m

* 3 % average annual growth (2013 base year)
Source: own calculation, based on BigHospitality 2013 estimate[48]

2.8.5 Supply chain and raw materials

As shown in Table 20, most household products (including dishwashing products) in Western Europe are sold through supermarkets. Supermarkets are able to control the amount of product on shelves and often price promotions in store. They are, therefore, an important part of the supply chain for the dishwashing detergent manufacturers. The presence of private labels is also significant for HDDs, and supermarket own-branded products are prevalent on the market.

Table 20: Western Europe, distribution channels by value (%), 2009

Channel	%
Supermarkets / hypermarkets	62.4 %
Independent retailers	19.6 %
Pharmacies / drugstores	8.2 %
Convenience stores	4.5 %
Cash & carry and Warehouse clubs	1.8 %
Department stores (incl. Duty-free shops)	1.2 %
Others	2.4 %

Source: Datamonitor (2011) *Household products market in Western Europe to 2014*

2.8.5.1 Raw materials

Any changes in availability of raw materials impact on the price of products which use those materials. The dishwashing detergent market relies on a number of ingredients, including:

- surfactants
- preservatives/biocides
- enzymes
- dyestuffs
- complexing agents
- bleaching agents
- anti-corrosion agents
- anti-foaming agents.

Annex II provides more detail about each of these ingredients.

[52] Morning Advertiser (2013) *P&G Professional launches extra tough Fairy washing-up liquid.* [online] Available at: http://www.morningadvertiser.co.uk/Pub-Food/P-G-Professional-launches-extra-tough-Fairy-washing-up-liquid
[53] includes hand dishwashing detergents, dishwasher detergents, kitchen surface disinfectants, hand hygiene and care
[54] Euromonitor International, cited on A.I.S.E website http://www.aise.eu/our-industry/market-and-economic-data.aspx

In the home and fabric care speciality ingredient market[55] there are an estimated 40-50 companies, with the dominant players mainly being speciality surfactants companies. However, the market is also characterised by an increasing degree of consolidation, which alters the number of competing organisations.

Table 21 shows the percentage revenues for each of the key ingredients in the home and fabric care speciality ingredients market.[53]. In 2008 the largest market share in terms of revenue was speciality surfactants with 34.4 % of the market, followed by fabric enhancing chemicals (23.2 %), functional polymers (22.6 %) and rheology modifiers (14.1 %). Active ingredients – comprised of disinfectants, bactericides and preservatives - held the smallest market share amongst the speciality chemicals with only 6.1 % of the market.[56]

Table 21: Total home and fabric care speciality ingredients market[53]: % of revenues by chemical type, Europe, 2008

Speciality surfactants	Functional polymers	Fabric enhancing chemicals	Active ingredients	Rheology modifiers
34 %	23 %	23 %	6 %	14 %

Source: Adapted from Frost & Sullivan (2009) Strategic analysis of the home and fabric care speciality ingredients market in Europe.

The speciality chemical market for home and fabric care is facing a number of challenges over the next decade which may alter current business practices. Table 22 ranks the top eight challenges which the industry is expected to face, along with an indication of the impact that this may have on organisations. The top challenge (volatility in oil prices) relates directly to the manufacture of raw materials. This is something which many organisations are now adapting to, helping to drive increased innovation and research in the use of plant-based chemicals.

Table 22: Home and fabric care speciality ingredients market[53]: impact of top eight industry challenges ranked in order of impact, Europe

Rank	Challenge	Expected impact 5-7 years
1	Volatility in crude oil prices affects costs across the supply chain	High
2	REACH creates scepticism in the home and fabric care speciality chemicals market	High
3	The trend for concentrates lowers the amount of chemicals used	High
4	The largest buyers exert pressure backwards in the supply chain	High
5	Consolidation in the industry alters the market dynamics (e.g. larger supplier may have greater control over the market)	High
6	Product switching due to price shortens the life cycle of products	High
7	Increase in multifunctional products that cater for more than one 'job'	Medium
8	Increase in the use of natural proteins as fabric enhancers	Medium

Source: Adapted from Frost & Sullivan (2009) Strategic analysis of the home and fabric care speciality ingredients market in Europe.
Note, this table was produced in 2009

Overall, there is potential for growth in the dishwashing detergent market, which translates to growth in the raw materials market. However, innovation in raw materials is being rapidly driven by a push from consumers who are increasingly demanding more from detergents and pushing for the use of more natural products in HDDs.[57]

[55] This includes: dishwashing products; hard surface cleaners; car interior and upholstery cleaners; furniture, shoe and leather polishes; and fabric washing and care.
[56] Frost & Sullivan (2009) *Strategic analysis of the home and fabric care speciality ingredients market in Europe.*
[57] Frost & Sullivan (2009) *Strategic analysis of the home and fabric care speciality ingredients market in Europe.*

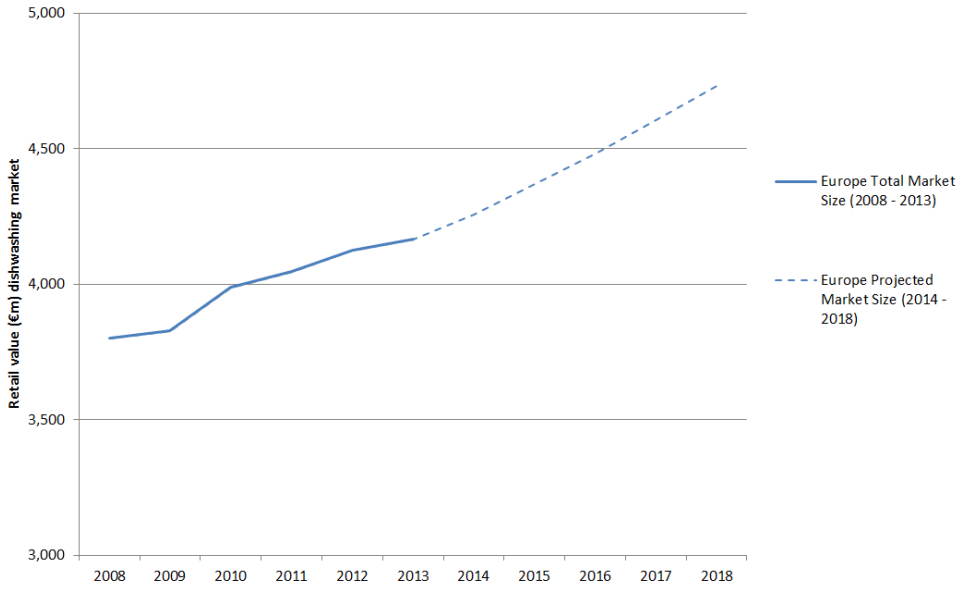
2.9 Trends and innovations

2.9.1 Market trends

Figure 2 shows the trends in retail value for the dishwashing detergents market (including hand and automatic dishwashing detergents) across Europe. There is a clear upward trend in the product category, showing an expected increase from €3,800 million in 2008 to €4,732 million in 2018, a CAGR of 2.01 %.

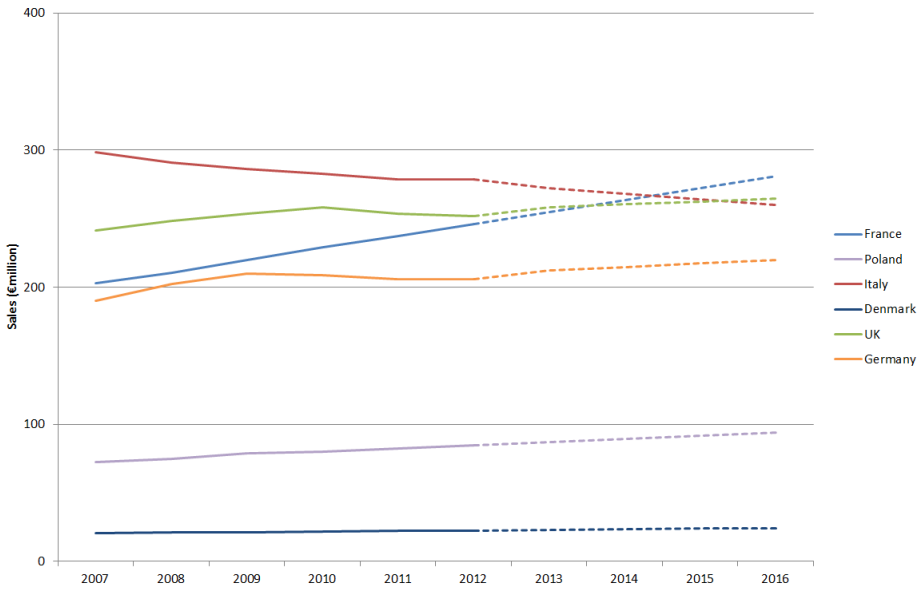
For HDDs only, data are available for the six Member States analysed in this report (France, Poland, Italy, Denmark, UK and Germany). Figure 3 shows the actual and projected retail sales values for each of these six countries, to 2016. Sales of HDDs are projected to increase in all with the exception of Italy, which shows a downward trend from 2012. By 2016, sales values in Italy are projected to decrease from 2007 values by almost €38 million. However, it should be noted that this downward trend is based on projections of activity between 2007 and 2012. In Italy between 2012 and 2013, sales values actually remained the same, rather than continuing in a downward trajectory. This suggests that the clear decrease in sales values since 2007 may be slowing and the projection to 2016 may be more positive than outlined in Figure 3.

The value increase between 2007 and 2016 is an estimated €23 million in the UK, an estimated €78 million in France, €30 million in Germany, €22 million in Poland and €4 million in Denmark.



* Includes HDDs and detergents for dishwashers
** Europe excludes Cyprus, Estonia and Malta due to lack of data
Source: Adapted from Passport data, *Market Sizes (2008-2018)*

Figure 2: Actual and projected total retail value (€ m) of dishwashing detergents* in Europe, 2008-18**



Source: Adapted from Passport data, *Market Sizes, Dishwashing (2008-2018)*

Figure 3: Actual and projected sales value (€ m) for countries with top five market share in dishwashing detergent value across Europe, 2008-18

Table 23 provides more information about the change in sales value, in terms of percentage, between 2007 and 2016.

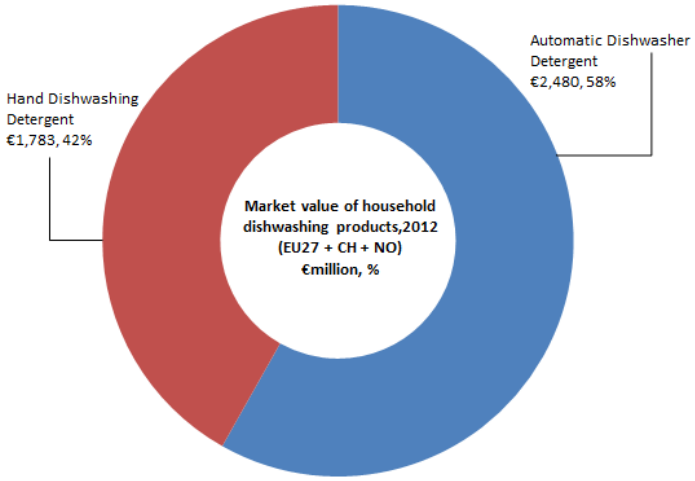
Table 23: Percentage change in the EU market (sales value) for HDDs

	% change 2007 - 2016	CAGR 2008 - 2016
France	38 %	3.7 %
Poland	30 %	3.0 %
Italy	-13 %	-1.5 %
Denmark	18 %	1.5 %
UK	10 %	1.0 %
Germany	16 %	1.6 %

- France is expected to have the highest increase in sales value between 2007 and 2016 with an increase of 38 %; a CAGR of 3.7 %.
- Sales in Poland are expected to increase by 30 %, in Denmark by 18 %, in Germany by 16 %, and in the UK by 10 %.
- Only Italy shows a projected decrease in sales value from 2007 to 2016; a decrease of 7 % and a CAGR of 1.4 %. Although this may only be a small decrease in terms of percentage, this is significant in value and quantity terms as Italy consistently has the highest total sales value in comparison to the other countries analysed. There are many likely reasons for this decrease, the most obvious being the possible links to the automatic dishwasher detergent market – i.e. does the sale of automatic dishwasher detergents directly replace purchase of HDDs? This is analysed in section 3.3.1.1.

2.9.1.1 Hand dishwashing versus automatic dishwashing

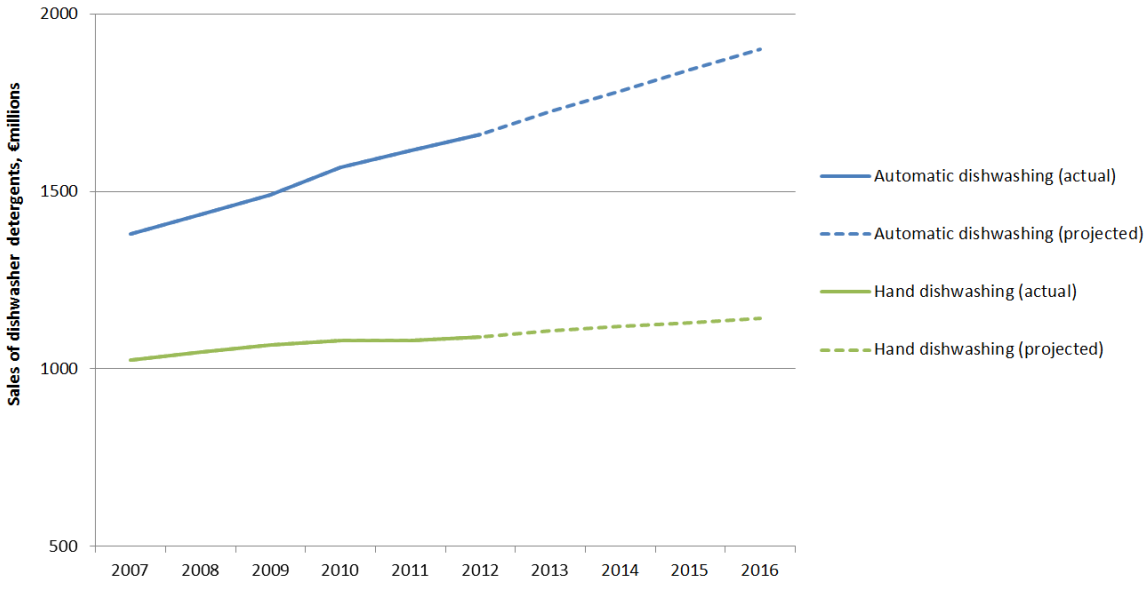
Figure 4 provides a comparative overview of the size of the market for HDDs (€1,783 million) and automatic dishwasher detergents (€2,480 million). This equates to a market value of over €4 billion in 2012 for the entire household dishwashing product category.



Source: Euromonitor International, data cited in Passport (2014) *Market sizes Europe, Dishwashing*

Figure 4: Market value and % share of all household dishwashing detergents, Europe, 2012

Figure 5 summarises the predicted trends in total sales of both automatic and hand dishwasher detergents, across the six countries analysed throughout this report. These products are often seen as direct competitors, although many householders who own a dishwasher will also purchase HDDs. Even so, it is predicted that sales of HDDs will slow, while still increasing, alongside a more dramatic rise in sales of automatic dishwashing detergent products.

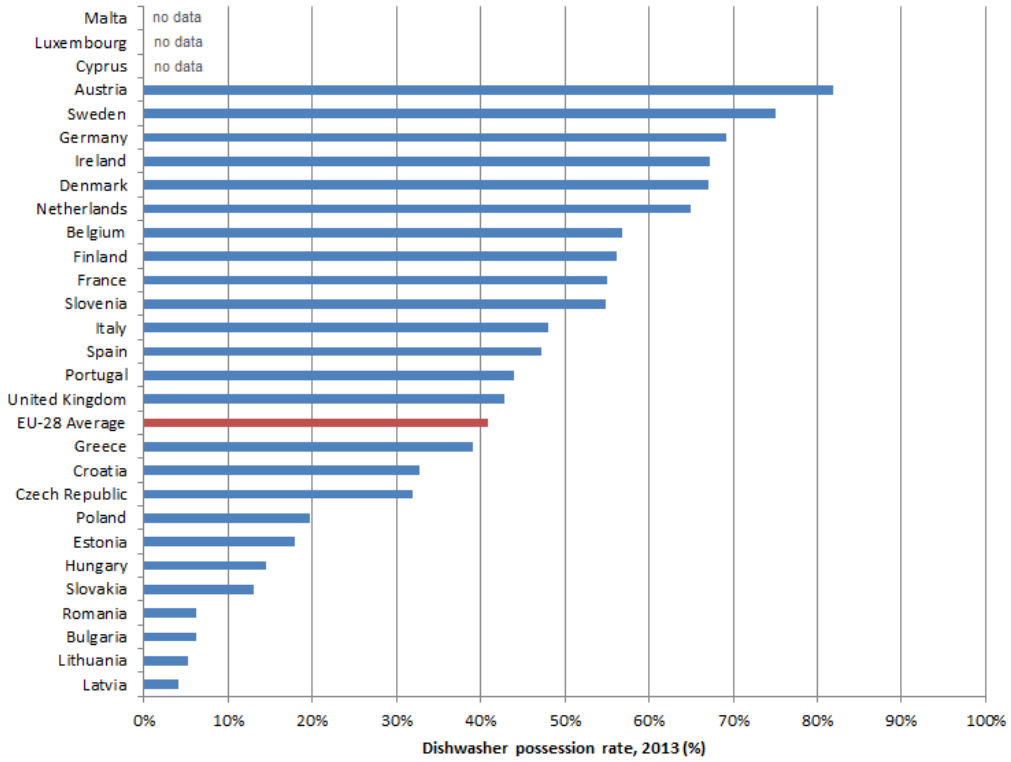


Source: Adapted from Passport data, *Market Sizes Europe, Dishwashing (2008-2018)*

Figure 5: Total actual and projected sales (€ m) of dishwasher detergents, 2007-16, (FR,PL,IT,UK,DE,DK)

Figure 6 outlines the percentage of households which owned dishwashers in 2012. This number is expected to increase by over 1 million more dishwashers in use – in the UK for example, the market penetration of dishwashers increased from 34 % in 2006 to 40 % in 2012.[58] In turn, this is expected to lead to an increase in sales of automatic dishwasher detergents.

[58] Mintel (2011) *Dishwashing Detergents UK*



Source: Euromonitor International, Data used in Passport report, *Possession rates (2013)*

Figure 6: Dishwasher possession rates (%), EU-28, 2013

Although there has been growth in the number of households with a dishwasher, and this growth is likely to continue, there are still significant opportunities for HDDs. It is estimated that in 2020, more than 90 million households in Western Europe will still wash up by hand.[59] For example, it is estimated than in Italy, 95 % of households still do some hand washing (2012 data).[60] This is partly due to households still washing up many items by hand even if they own a dishwasher, but could also be a result of consumers trying to save money and reverting to dishwashing by hand.[58]

This widespread use of hand dishwashing is also shown in Table 24, which estimates the share of items being washed up manually in households in four Member States: Germany, Italy, Sweden and the UK.

Table 24: Share of items being washed up manually (%)

	Germany	Italy	Sweden	UK
Dinner plates	7 %	31 %	9 %	19 %
Soup plates	23 %	27 %	14 %	17 %
Cups	12 %	43 %	26 %	26 %
Saucers	17 %	62 %	11 %	26 %
Bowls	25 %	42 %	29 %	27 %
Casseroles	25 %	62 %	33 %	43 %
Plastic items	39 %	47 %	45 %	40 %
Plastic items	64 %	49 %	28 %	73 %
Pots	51 %	62 %	71 %	58 %
Pans	71 %	54 %	91 %	65 %
Other Items	65 %	78 %	80 %	77 %

Source: Richter (2010), cited in Novozymes (n.d.) *Manual dishwashing,* Household care

[59] Novozymes (n.d.) *Manual dishwashing,* household care
[60] Passport (2012) *Dishwashing in Italy*

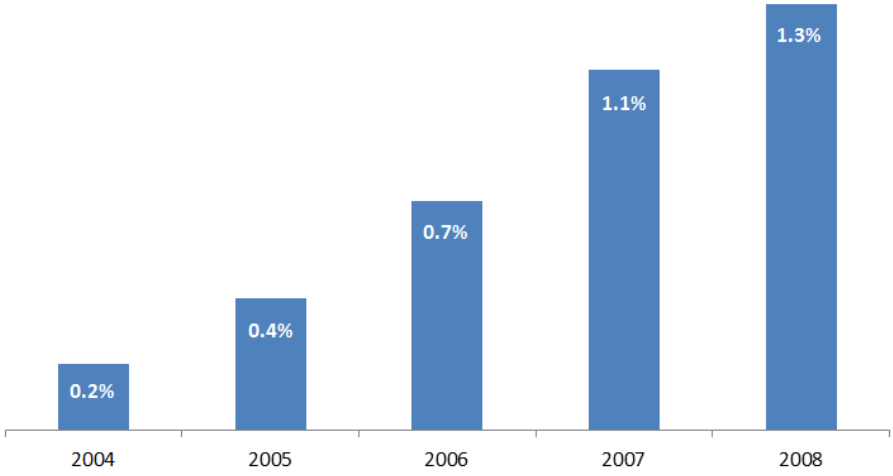
To conclude, it is expected that the HDD market will continue to grow, although this will likely be at a slower rate than the automatic dishwashing detergent market. Importantly, there is only a partial trade-off between these two products as even households with a dishwasher are likely to continue to wash some items by hand. However, as dishwasher ownership increases, there will likely be some negative impact on sales of HDDs.

2.9.2 Sustainable cleaning product innovations

Consumers of household care and industrial cleaning are placing a higher emphasis on sustainability when purchasing products. This is reflected by the increasing number of product innovations and launches which focus on environmental claims. It is no longer just niche brands, but global brands now also advertise the green credentials of their cleaning products to encourage sales.

As a response to this increasing focus on environmental issues, a number of companies with 'pitches' centred on sustainability have joined the market, including brands such as Ecover and Method which can now be commonly found in supermarkets across Western Europe. Private label manufactures are also increasingly developing cleaning products with 'green credentials'.[61]

Among the multinational 'green cleaning' brands, Ecover is the most prominent, with significant sales across main Western European markets. Figure 7 shows the scale of this growth between 2004 and 2008 in the UK, one of the largest markets for Ecover in Europe – Ecover saw an increased share of 1.1 % of the total household care market in this period.



Source: Adapted from Euromonitor International (2009) *Global Household Case: Green Cleaning – Still an Oxymoron?* September 2009

Figure 7: Ecover's Share Increase (% of total household care) in the UK 2004-08

Typically, innovation in the household cleaning market is driven by larger brands, with occasional innovative product launches from smaller, niche brands. Where these brands are successful, private labels (such as own-branded supermarket products) typically move into the market with a similar product offering. 'Green' cleaning products have been a success across the cleaning products market, which has led to private labels launching similar offerings and establishing a significant presence in the environmentally-friendly cleaning market.

These private label green cleaning products include:

- UK: Tesco's *Naturally* range of household care products - made from plant-based ingredients, not tested on animals and free from synthetic colours.
- UK: Asda's *Eco-Friendly* brand includes HDDs.
- UK: Co-operative own brand products include the *Ecological Concentrated* HDDs.

[61] Euromonitor International (2009) *Global Household Case: Green Cleaning – Still an Oxymoron?* September 2009

- Switzerland: the Migros supermarket chain has launched a range of environmentally-friendly products under the brand *M-Plus*.

Private labels can often be found at lower prices than their branded equivalents – this drives the purchase of private label 'green' products by consumers who are both eco-conscious and price-sensitive. However, although private labels are maintaining the balance between green benefits and price, these eco-products can often be considered as less efficient than the standard products.[62]

Overall, the trend for environmentally aware 'green cleaning', including dishwashing, remains strong. Several of these environmental trends are outlined below.

2.9.2.1 Green ingredients

The use of green or natural ingredients in HDDs has become relatively widespread and a number of the larger supermarket chains stock products which are marketed as having eco-friendly ingredients. These products include:

- Orientea Enterprise Co Ltd HK launched *Orientea* in Japan. The product is made from organic tea leaves and contains no ingredients derived from petrochemicals.
- Ecover, the largest brand of eco-friendly cleaning products, uses plant based and mineral ingredients in its HDDs.
- Like Ecover, the Method HDD uses a number of plant based ingredients and the product is biodegradable.
- The *Bio D Concentrated* low foam washing up liquid contains a number of eco-friendly ingredients such as vegetable oil, citric acid and vegetable glycerine.

2.9.2.2 Packaging minimisation

Packaging minimisation is becoming standard for a variety of products, not just HDDs. Minimising packaging not only helps reduce the amounts of plastics, etc. which needs to be produced and sent to landfill, but also reduces the cost of manufacture. The majority of the larger HDD manufacturers have recently focused on light-weighting packaging for a number of products in the household care market.

Some manufacturers (primarily those with an environmental focus) have developed re-usable/refillable bottles for their HDDs. For example, both Method and Ecover sell a refillable bottle and washing up liquid refills, all in recyclable packaging.[63]

2.9.2.3 Other considerations

Concentrated detergents: The idea of concentrating HDDs to ensure that less is used in a typical wash is not new – the original 1960s *Fairy* liquid campaigns were focused on this. Many products also market this to prove efficacy, rather than for environmental reasons. However, this is a widespread theme in the dishwashing detergents market, aimed at reducing the amount of product used, packaging needed and transportation required per item. For example, Henkel launched *Pur 3xAction* in 2012 which is marketed as 50 % thicker than comparable HDDs. The manufacturers of this product claim that a small amount is enough for a large amount of washing up, and so the product lasts longer imparting to it all the properties listed above.

Water saving: Although not a trend (this is a very new concept which only one product is advertising), a washing-up liquid has been developed in Japan which claims to reduce the amount of water used in washing up. The *Terra Eco Clean* hand dishwashing detergent was introduced in 2012 by Natural Terra. The detergent contains an extra palm oil surfactant which is claimed to break down grease more easily, requiring less water to rinse dishes.[64]

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[62] Euromonitor International (2009) *Global Household Case: Green Cleaning – Still an Oxymoron?* September 2009
[63] Available at: http://methodproducts.co.uk/ind_wash_refill_cle.html
[64] Datamonitor (2009) *New household goods review: Ethical lines grow in an array of categories.* [online] Available at: http://www.datamonitor.com/store/News/new_household_goods_review_ethical_lines_grow_in_an_array_of_categories?productid=7D670248-A50E-459E-A546-A30748497F98

2.9.3 Eco-labelling

Environmental labelling schemes are becoming widely used for a number of consumer products, including for dishwashing detergent and other cleaning and household care items. These labelling schemes can be particularly useful to private labels in the cleaning market as they can be used to persuade consumers of the benefits of own-brand products, without the need for costly marketing strategies akin to the larger brands. For example, in the UK, Sainsbury's *Cleanhome* product range (launched in December 2007) has been certified by both the EU Ecolabel and the Swedish Falcon Good Environmental Choice label.

Table 25 provides an estimate of the number of EU Ecolabel HDD products manufactured and sold in Europe. The first column (country) indicates the country which awarded the EU Ecolabel to various manufacturers and products; this is also the country in which the product is manufactured. 42 manufacturers have been awarded the EU Ecolabel for a total of 85 products.

There is reasonable availability of EU Ecolabel HDDs across Europe. However, only 11 of 28 European countries manufacture any products which have been awarded the EU Ecolabel; all other countries rely on the import of Ecolabel products. Table 26 indicates how many Ecolabel products are available in each EU country. France has the highest number of products available (37), followed by Spain (35). Croatia is the only country which has no EU Ecolabel products available on the market, although availability is also low in Bulgaria, Cyprus, Estonia, Malta, Slovakia and Slovenia (each with only one product).

Table 25: EU Ecolabel HDD products manufactured and sold, by country (EU-28 + Norway)

Country	No. of manufacturers awarded the EU Ecolabel	No. of products awarded the EU Ecolabel	Countries where products are sold (Europe only)
Austria	1	1	Austria
Belgium	6	35	Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Spain, Sweden, UK
Cyprus	1	1	Cyprus
Czech Republic	1	1	Czech Republic
Denmark	1	1	Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden
Germany	6	11	Austria, France, Germany, Hungary, Italy, Poland, Portugal, Romania, Slovenia
Spain	18	27	France, Germany, Greece, Hungary, Ireland, Italy, Malta, Netherlands, Portugal, Spain
Latvia	2	2	Denmark, Estonia, Finland, Latvia, Poland, Sweden
Netherlands	1	2	Netherlands, Sweden
Poland	1	1	Poland
UK	4	3	UK
TOTAL	**42**	**85**	

Source: EU Ecolabel E-Cat (last viewed on 07/08/2014) - http://ec.europa.eu/ecat/

Table 26: EU Ecolabel HDD products on the European market (EU-28)

EU Member State	No. of EU Ecolabel HDD products on the market*	EU Member State	No. of EU Ecolabel HDD products on the market*
Austria	4	Italy	14
Belgium	18	Latvia	3
Bulgaria	1	Lithuania	2
Croatia	0	Luxembourg	5
Cyprus	1	Malta	1
Czech Republic	5	Netherlands	9
Denmark	5	Poland	7
Estonia	1	Portugal	13
Finland	4	Romania	2
France	37	Slovakia	1
Germany	16	Slovenia	1
Greece	2	Spain	35
Hungary	3	Sweden	6
Ireland	5	United Kingdom	8

* Note, this may include the same product in different size packaging – e.g. 500ml and 1L varieties, and so does not give an indication of the number of brands or product types available in each country.
Source: EU Ecolabel E-Cat (last viewed on 20/08/2014) - *http://ec.europa.eu/ecat/*

In addition to the EU Ecolabel which operates across the EU-28, the Nordic Council has a set of Nordic Swan ecolabel criteria for HDDs. The Nordic Swan can be awarded to these items which are produced and marketed in its five Member States, i.e. Sweden, Denmark, Finland, Norway and Iceland. Due to the similarities between the EU Ecolabel criteria and the Nordic Swan criteria sets for HDDs[65], it is worthwhile to identify the number of such products which carry this label on the European market (Table 27).

Table 27: Number of Nordic Swan labelled HDDs on the EU-28 market

Nordic Swan Country	No. of Nordic Swan-labelled HDDs on the market
Denmark	70
Norway	8
Sweden	42
Finland	11
Iceland	0
Total	**131**

Source: Danish Ecolabelling website/product catalogue, Norwegian Ecolabelling website/product catalogue, Swedish Ecolabelling website/product catalogue, Norway ecolabelling website/product catalogue

Across Europe, the number of Nordic Swan labelled HDDs is higher than the number of EU Ecolabel products. For many small Scandinavian producers of HDDs it may be that the local market is more vital than the European market, and so the Nordic Swan label may be more familiar and accepted by producers and consumers alike. This may result in a lack of incentive for smaller producers to acquire both a regional label (Nordic Swan) and an EU Ecolabel.

[65] Nordic Ecolabelling of Hand dishwashing detergents, 025 Hand dishwashing detergents, version 5.0, 28 May 2012. Available from http://www.nordic-ecolabel.org/criteria/product-groups/

There are a number of other national environmental labelling programmes operating in Europe that have criteria for HDDs, including: Austrian Ecolabel for Hand dishwashing detergents[66] (about 15 HDDs have been awarded this label) and the Czech Ecolabel for detergents for hand dishwashing[67].

A number of labels are also used throughout the rest of the world, including:

- Environmental Choice (New Zealand) label for HDDs.[68]
- Good Environmental Choice (Australia) for HDDs.[69]

2.9.4 Consumer trends and market innovations

The HDD market is highly competitive and price sensitive, although it is dominated by a few large brands alongside private label products. The scope for innovations in this market is somewhat limited to either the design or functionality of the container or the formulation of the detergent product. By adding additional value to the product, manufacturers are able to raise unit prices and maintain profit margins.

2.9.4.1 Fragrance

The introduction of fragrance to cleaning products is a key trend, seen across a number of household product categories. Cleaning product launches often focus on fragrance, and this has become a point of differentiation between products which are otherwise very similar (including dishwashing detergents).[70] Typically, most dishwasher detergent brands produce a range of products with various fragrances, tailored to each market. For example, the *Fairy aromatics* range of washing up liquid includes fragrances such as apple, pomegranate and tangerine & ginger. Persil has also launched a fresh scents range[71] which, as well as including new 'fresh' fragrances (including Apple Fizz, Orange Crush, Pink Blush and Lemon Burst), has been given new packaging to "stand out on the shelf".[72]

A number of the larger green cleaning brands also market products with a focus on fragrance, including Ecover's hand dishwashing detergent (pomegranate & lime, chamomile & marigold, lemon & aloe vera and grapefruit & green tea[73] scented) and Method's dishwashing detergent which can be purchased in either clementine, cucumber, lemon mint or pink grapefruit scents.[74]

In the US this trend has been taken further, and a washing up liquid with an air freshener attached to the base has been launched by Proctor & Gamble – designed to freshen the kitchen as well as clean the dishes.[75]

In response to this increase of fragranced products, several brands are introducing fragrance-free HDDs - many of the more niche eco-brands already included fragrance-free HDDs in their product portfolios. More information about this is in Section 3.3.4.4 which outlines this opposing trend.

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[66] Austrian Ecolabel, hand dishwashing detergents, Available from https://www.umweltzeichen.at/cms/home/produkte/haushalt-und-reinigung/content.html?rl=46

[67] Technical Guidelines, Detergents for hand dishwashing, V67, 2012, Ministry of Environment available from: http://www.cenia.cz/web/www/web-pub2.nsf/$pid/MZPMSFHMV9DV/$FILE/672012.pdf

[68] The New Zealand Ecolabelling Trust: Licence criteria for hand dishwashing detergents, EC-01-14, January 2014. Available from: http://www.environmentalchoice.org.nz/docs/publishedspecifications/ec0114_hand_dishwashing_detergents.pdf

[69] The Australian Ecolabel Program: Cleaning Products, Version 2.2 November 2013. Available from: http://www.geca.org.au/media/medialibrary/2012/08/GECA_15-2006_Hand_Dishwashing_Detergents_May_2012.pdf

[70] Datamonitor (2014) *Datamonitor's Market Data Analysis*

[71] Available at: http://www.persildishwash.co.uk/hand-dishwashing#.U86K3fldWnQ

[72] Talking Retail (2011) *Unilever relaunches Persil washing up liquid.* [online] Available at: http://www.talkingretail.com/products-news/household/unilever-relaunches-persil-washing-up-liquid/

[73] Available at: http://uk.ecover.com/en/household-cleaning/product/washing-up-liquid#var103

[74] Available at: http://www.methodproducts.co.uk/prod_washingup.html

[75] Datamonitor (2007) *New household goods review: a fresh approach for toilet seats.* [online] Available at: http://www.datamonitor.com/store/News/new_household_goods_review_a_fresh_approach_for_toilet_seats?productid=B8EA70FB-959A-419F-9850-6F5304AFBC56

2.9.4.2 Additional benefits and functionality

Adding an extra benefit or function to HDD allows manufacturers to maintain higher unit prices. Many recent launches of HDDs have concentrated on multi-functional aspects of the product. In particular, the focus has been on cleaning the sink whilst also cleaning the dishes. Typically, the sink area can suffer from odour problems and requires regular cleaning. Combining dishwashing detergent with a sink freshener is seen to add value to the product. Examples of these products include Colgate-Palmolive's *Dish + Sink* range, which combines washing up liquid with a sink and drain freshener.[76]

A similar product was launched in the US by Procter & Gamble; *Dawn platinum erasing dish foam*. This product aims to remove odours from plastic containers (such as lunchboxes or storage boxes) which may to be used for foods such as onions, fish or eggs, where odours permeate into the plastic.[77] The dishwashing liquid therefore performs two functions: cleaning and removing odours from the containers.

It is also increasingly common for products to offer '*antibacterial properties'*. For example, the *Fairy anti-bacterial* range of HDDs claims to kill 99 % of germs in the washing up sponge as well as clean dishes. The product is advertised as offering "*24 hour protection for your sponge"*, which can quickly become unsanitary if not also regularly washed or replaced.

In contrast to this focus on antibacterial cleaning, several HDDs have been formulated using edible ingredients, with the aim of reassuring consumers that these products are safe and can be used to wash fruit and vegetables. For example, *Safe Sprouting Brown Rice* by LG Household & Health Care Ltd contains rice extract which is traditionally used for dishwashing in South Korea.[78]

Several products have also been marketed as suitable for washing up purposes, even if this is not their main purpose. These products include: Stardrops *all round cleaner*, which can be used for washing up as well as other cleaning (hard and textile surfaces, windows, bathrooms, kitchens etc.)[79], and Cillit Bang *Grease & Sparkle,* which can be used to help with tougher, baked-on dirt when washing dishes. Both of these products are marketed as all-purpose (including the functionality to be used when washing dishes) and so are sold to consumers who would rather purchase one product rather than a range for all different purposes.

2.9.4.3 Premium products

The HDD market is fairly homogenised in that there is little difference between the format of the product (i.e. liquid or gel) or even the type of bottle which the product is sold in. To establish a market share, it is therefore important for manufacturers to try and distinguish their product in terms of functionality. Efficacy of the product is important and a number of manufacturers have recently launched premium products which claim to work faster and better than others on the market.[80]

For example, Procter & Gamble introduced the *Fairy Platinum* range in 2012, which claims to reduce the time needed to soak dishes from overnight to just 10 minutes. Due to this additional functionality, the product can be sold at a price premium. This trend has also been seen in the private labels, including Tesco's *Expert washing up liquid.*

2.9.4.4 Mild on hands

Dishwashing detergents are one of the few cleaning product which typically come into contact with consumers' skin in significant doses. Many manufacturers are responding to consumer demand and integrating skin care into hand dishwashing products. This is not necessarily a new development; *Fairy* washing up liquid was

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[76] MarketLine Industry Guide (2014) *Household products.* [online] Available at: http://www.reportlinker.com/ci02166/Household-Products.html

[77] Euromonitor International (2007) *Hand dishwashing still an attractive market for trendsetters.* [online] Available at: http://www.marketresearchworld.net/content/view/1609/77/

[78] Euromonitor International (2009) *Global Household Case: Green Cleaning – Still an Oxymoron?* September 2009

[79] Available at: http://www.stardrops.co.uk/

[80] Transworld News (2014) *UK dishwashing market: £418 million industry by 2017* [online] Available at: http://www.linkmyfan.com/1546444/id201160/p1/uk-dishwashing-market-418-million-industry-by-2017

originally marketed with the tag line "*now hands that do dishes can feel soft as your face*". However, a number of products have been launched in the past few years which contain added lotions and moisturising agents.[81]

In the UK, for example, *Fairy clean and care* (in fragrances including aloe vera & cucumber, rose & satin or chamomile & vanilla) has been developed to include *Olay* moisturiser. This product combination combines washing up with a luxury skin care brand, and allows the product to be sold at a price premium.

Products created specifically for sensitive skin are also becoming more popular in both developed and developing markets. As a response to the proliferation of highly scented products on the market, a number of brands (most commonly the 'eco-cleaning' brands) are developing products which typically contain no/limited fragrance and natural products only. These products are marketed towards consumers with sensitive skin who may be irritated by dishwashing detergents. Examples of this include *Ecozone sensitive* washing up liquid and Ecover *ZERO* washing up liquid for sensitive skin. Proctor & Gamble also manufactures a 'sensitive' range of HDD which is marketed as being dermatologically tested.

2.9.4.5 Foaming dishwashing detergents

The US has begun to see another trend emerging in the dishwashing detergents market; foaming cleaners. These foaming detergents rely both on the development of new dispensing systems, and on new formulations for the detergents themselves. One example of this is Palmolive's *Oxy Plus Foam,* launched in 2006. The product consists of a pump top bottle which produces foam, instead of a liquid or gel. This product aims to offer convenience to consumers as there is no need to pre-soak dishes. Instead, the foam can be pumped onto a cloth or onto the dishes in order to clean.[79]

A similar product type has been introduced by Method with its *power foam dish soap.*[82] Again, this product consists of a pump top which produces a foaming detergent. Method also markets the convenience aspects and aims this product at consumers who lead busy lives or who do not produce enough dishes to justify filling a sink with water. Instead, the foam can be directly applied to a sponge or to individual dishes.

2.10 Summary

- The total retail value of the EU market for HDDs (EU-27 + CH + NO, 2012) is €1.8 billion.
- The I&I market for all kitchen and catering detergents is valued at an estimated € 1.5 billion (this includes, but is not exclusively, HDDs).
- It is expected that the HDD market will continue to grow, although in the coming years this will likely be a slower growth than the automatic dishwashing detergent market. Importantly, there is only partial trade-off between these two products (although if a household purchases a dishwasher it is expected that HDD sales will decrease somewhat), and even households with a dishwasher are likely to continue to wash some items by hand.
- Private label household cleaning products are common across Europe and represent an estimated 22 % of all brands available. The rest of the market is dominated by a small number of large manufacturers, including Reckitt Benckiser Plc (24 %), Procter & Gamble (13 %), Henkel (13 %), Unilever (12 %) and Colgate-Palmolive Co (4 %).
- The HDD market is mainly domestic, with imports and exports primarily intra-EU. There is, however, a degree of extra-EU trade.
- Innovation in the HDD market is relatively limited, and is primarily focused on adding additional functionality to the product. The larger brands drive this innovation, although many private label manufacturers have developed a range of own-brand products including a budget variety, premium products and environmentally friendly versions.

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[81] Euromonitor International (2007) *Hand dishwashing still an attractive market for trendsetters.* [online] Available at: http://www.marketresearchworld.net/content/view/1609/77/

[82] Further information available at: http://www.methodproducts.co.uk/ind_powerfoam_pinkgrapefruit.html

- Consumer choice of HDD is driven by ease of use of the product, price, health and safety during use of the product and efficacy of the product. This has led to a number of developing trends in the cleaning market, in particular: the use of fragrance, the development of chemical free products (or products which include moisturising lotions) which are gentle on hands and a focus on premium products that claim to reduce the time required to wash-up or soak dishes.
- Sustainability in the cleaning products market is becoming important for consumers, and therefore manufacturers. Innovations in the sustainable offerings include an increased use of green/plant-based chemicals and a focus on minimising packaging, however, for the time being this tendency is not enough to be fully representative at European level and/or properly quantified.

3. TECHNICAL ANALYSIS

3.1 Technological aspects

3.1.1 Supply chain for HDD production

An overview of the supply chain for home and fabric care products, including HDDs, is shown in Figure 8. Manufacturers of HDDs (formulators/blenders such as Procter & Gamble, Unilever and Henkel) acquire ingredients such as surfactants from speciality manufacturers and then blend these to produce HDDs.

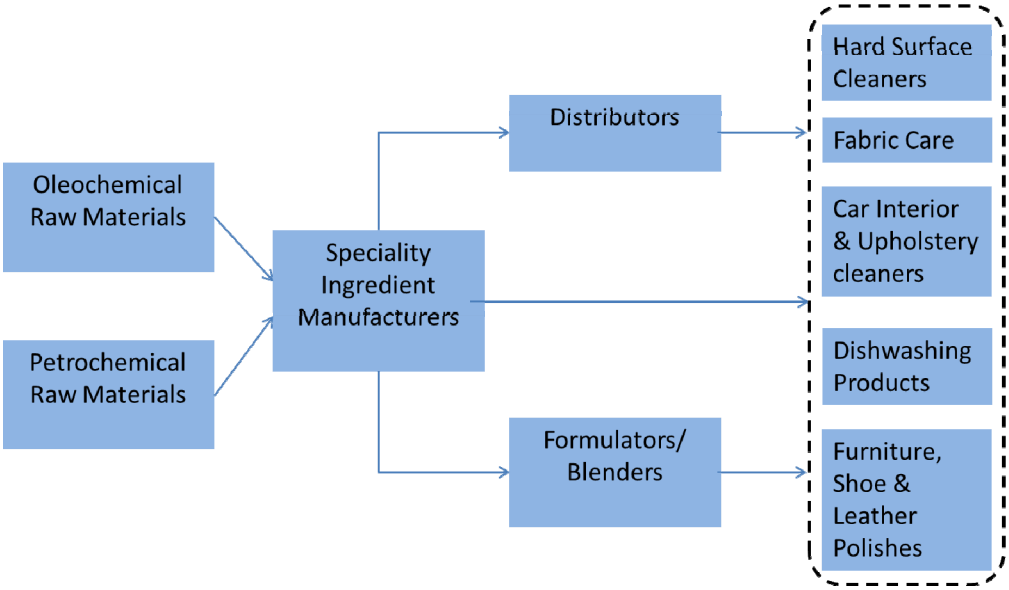

Figure 8: Supply chain for home and fabric care products

The raw materials used for the production of detergent ingredients are obtained either from oleochemical sources or petrochemical sources. Oleochemical raw materials are derived from plant and animal fats; these include coconut oil, tallow, palm kernel oil and palm oil.[83] These raw materials are often referred to as renewable raw materials. Petrochemical raw materials are derived from crude oil or natural gas; these materials are often termed synthetic. According to the American Cleaning Institute, there is no inherent environmental advantage to using surfactants from one source over the other and there are environmental trade-offs associated with both oleochemical and petrochemical sources.[84]

Companies active in the European market for detergent speciality ingredients include Clariant, Rhodia, Solvay, Rohm & Hass, Cognis, Croda, Dow Corning, Elementis, Alco Chemical and BASF, amongst others. Within the home and fabric care ingredients sector, speciality surfactants hold the largest market share in Europe.[85]

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[83] Palm kernel oil, coconut oil, and palm oil are three of the few highly saturated vegetable fats; these oils give the name to the 16-carbon saturated fatty acid palmitic acid that they contain. Splitting of oils and fats by hydrolysis, or under basic conditions saponification, yields fatty acids, with glycerin (glycerol) as a byproduct. The split-off fatty acids are a mixture ranging from C_4 to C_{18}, depending on the type of oil/fat. The palm, palm kernel and coconut cultivation has been criticized for impacts on the natural environment, including deforestation, loss of natural habitats. In particular, the cultivation of palm has threatened critically endangered species such as the orangutan and Sumatran tiger and increased GHG emissions. Many palm oil plantations are built on top of existing peat bogs, and clearing the land for palm oil cultivation may contribute to GHG emissions. Source: Wikipedia

[84] Sustainability resources from the American Cleaning Institute, available from: http://www.cleaninginstitute.org/sustainability/some_facts_about_4.aspx

[85] Henkel (2011) *The world of fragrances; how washing and cleaning can affect the senses.* Available at: http://www.henkel.com/henkel-headlines/news-2011-20111024-the-world-of-fragrances-34010.htm

3.1.2 Description of the HDD production processes

The first step of HDD detergent production is to select the ingredients. This is done according to several criteria which will typically include cost, sustainability, human health, environmental safety and performance. Detergent manufacturers use different approaches to ensure that their products have the least impact on the environment and human health. One example of such an approach is the *Greenlist*™ process developed by SC Johnson, which scores ingredients by their impact on the environment and human health. Using the process, a final product score is obtained which takes into consideration the environmental classifications of both chemical and packaging constituents.

The manufacturing process employed for HDD products in general consists of mixing and pumping the ingredients into mixing vessels. The exact process employed will depend on the manufacturer and the format of the final product. Liquid detergents are produced either in a batch process or a continuous process. The batch process is the simplest: ingredients are introduced to an agitated tank, and additional mixing or heating can be provided through a recirculation loop. In comparison, continuous processes are more sophisticated and better suited to large-scale operations. In a continuous process both dry and liquid ingredients are added and then blended using in-line mixers. The final manufacturing process for HDDs is packaging and typically involves plastic bottles.

A more detailed explanation of the production process of the detergents and the chemistry involved can be found in Annex VIII.

3.1.3 HDD detergents ingredients

HDDs are expected to clean all types of soil from dishware, to have copious long lasting foam, to be mild to hands and to have a pleasant fragrance[86] and are mainly composed of surfactants, preservatives, and additives. More information on detergent ingredients can be found in Annex I. HDDs are primarily a mixture of surfactants dispersed in water and these are used to remove and emulsify fats and aid with wetting. Commonly used anionic surfactants include alcohol ethoxylates such as LAS, alkane sulfonates and alkypolyglycosides.[83] HDDs must be safe and not damaging to the environment and therefore environmental parameters such as biodegradability, aquatic toxicity and bioaccumulation need to be taken into account. Further, they should be non-sensitizing and non-irritating. Further detail on specific detergent ingredients and their environmental performance will be provided in the technical report.

3.1.4 User behaviour

The consumer behaviour and dishwashing techniques throughout Europe have been studied among others by Prof. Dr. R. Stamminger and colleagues. Stamminger et al.[87] found that an important reason for not having a dishwasher at home is that there is not enough room in the kitchen. Other reasons include the number of people living in a household, and the performance and consumption values of automatic dishwashing. Nearly everybody has their 'own way' of manual dishwashing. Many variations and combinations of processes can be observed, ranging from a series of four 'baths' for each item to be washed (i.e. soaking, preliminary cleaning, cleaning, rinsing), to the use of continuously running hot water for about 30 % of the study group. The level of soiling and the number of items to be cleaned also influenced dishwashing behaviour.

The dishwashing behaviour of individuals was found to be surprisingly constant and not likely to be a matter of coincidence.[87] Consumer behaviour and dishwashing techniques greatly affect the amount of resources needed, i.e. water, energy, time, detergent.[85] Nevertheless, none of these resources showed a dominant influence on the cleaning performance individually. Therefore, differences in cleaning performance can be attributed to differences in dishwashing techniques, such as clever water management or the amount of mechanical power applied.

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[86] Handbook of Detergents, Part F: Production, Surfactant Science Series Volume 142, Uri Zoller and Paul Sosis, CRC Press, 2009.
[87] Stamminger R, A Elschenbroich, B Rummler, G Broil, 2007. *Washing-up Behaviour and Techniques in Europe.* Hauswirtschaft und Wissenschaft, 1, 31–37.

Fuss et al.[88] formulated best practice tips and studied whether they can be used to save resources by affecting behavioural changes. The researchers focused on common household conditions, such as large amounts of dishes, and observed a reduction in the use of resources (around 60 % less water, 70 % less energy, and 30 % less detergent) when the best practice tips were applied. A study by Stamminger and colleagues[89] showed that the average water consumption increases if the load to be cleaned is divided into smaller portions, from on average 103 litres for twelve place settings in one go to more than 121 litres for six times two place settings.

Consumers' attitude towards best practice tips is generally positive.[86] Although some concerns exist about their exact application in everyday life, the tips are generally highly accepted.

3.2 LCA review

Prior to performing an LCA analysis on the environmental performance of HDDs along their life cycle, a detailed LCA screening of publicly available studies was carried out. This screening has allowed the identification of the main environmental hotspots and their alternatives for this product group as well as the evaluation of the need for performing additional studies.

3.2.1 Selection criteria

Relevant LCA studies were identified in literature and critically reviewed for the robustness of their results. The criteria considered for this assessment were:

- **Subject of the studies**: The analysed products should have representative features of the product group, sub-categories, technologies or specifications.
- **Functional unit (FU):** The FU refers to a quantified performance of a product system for use as a reference unit in LCA studies.
- **Time-related coverage of data**: This refers to the year the inventory data of the analysis is based on; studies should ideally be less than 4 years old.
- **Comprehensiveness and robustness**: This refers to the environmental impacts considered in the study. Impact categories should be comprehensive, ideally reflecting the European Commission's Product Environmental Footprint (PEF) methodology or other recognized LCA methodologies and scientifically robust when considered against the evaluation provided in the JRC's ILCD Handbook. Studies should also be cradle-to-grave.
- **Reliability:** This refers to the information and the data quality provided by the authors. Studies should ideally be subject to an external critical review.

The different studies' compliance with the ISO standards for life cycle assessment (ISO 14040 and 14044) was considered as well as the information provided regarding:

- **Cut-off criteria**: According to the ISO 14040/44:2006 and the ILCD Handbook, cut-off criteria should be documented in an LCA study. The reasons for assuming cut-offs should be stated and their effects on results should be estimated.
- **Allocation**: Allocation rules should be documented in the description of the studies.
- **Data quality requirements and data sources**: Data quality level and sources of primary and secondary data should be documented, e.g. information on the geographical and technological representativeness of the selected LCA studies.
- **Assumptions:** Information and documentation of the important assumptions is crucial to ensure the transparency and reproducibility of the results. Therefore, information about the assumptions made whilst modelling, should be provided.

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[88] Fuss N, S Bornkessel, T Mattern, R Stamminger, 2011. *Are resource savings in manual dishwashing possible?* International Journal of Consumer Studies, 35: 194–200

[89] Stamminger R, Rummler B, Elschenbroich A, Broil G, 2007. *Dishwashing under various consumer-relevant conditions.* Hauswirtschaft und Wissenschaft, 2, 81–88.

It should be noted that the number of available LCA studies on HDDs is very limited; in fact only three studies were identified. No reports were excluded by the selection criteria described above.

3.2.2 Detailed revision and quality assessment of available studies

The number of publicly available LCAs on HDDs is very limited. Three studies were identified which described the environmental impacts of HDDs from a life cycle perspective, as summarised below and in Table 28.

1. Van Hoof et al.[90] described in IEAM a life cycle-based water assessment of a hand dishwashing product using a number of water assessment methods. Their goal was to identify product improvement opportunities and get an understanding of the potential for underlying database and methodological improvements.
2. Van Hoof et al.[91] showed in IJLCA three different normalization approaches that produce very different ranking of indicators, and can be used to select indicators in order to simplify LCA. The approaches are illustrated on a hand dishwashing case study.
3. The International Association for Soaps, Detergents and Maintenance Products (AISE) carried out a generic LCA on dishwashing detergents for manual dishwashing.[92]

Table 28: Publicly available LCAs on dishwashing detergents

Source	**Van Hoof et al, 2013 (IEAM)**	**Van Hoof et al, 2013 (JLCA)**	**AISE. 2014** (Charter update 2010. Version 1 January 2014)
Title	Life cycle-based water assessment of a hand dishwashing product: opportunities and limitations	Indicator selection in life cycle assessment to enable decision making: issues and solutions	ASP substantiation dossier: Household manual dishwashing (MDW) detergents.
Subject of the study and goal	A number of water assessment methods were applied to a hand dishwashing product with the purpose of identifying both product improvement opportunities, as well as understanding the potential for underlying database and methodological improvements. The use of a single formula with the same global supply chain, manufactured in one location was evaluated in two countries with different water scarcity conditions.	Normalization could be a means to narrow the list of indicators by ranking indicators vs. a reference system, and thereby simplifying LCA. This paper shows three different normalization approaches that produce very different ranking of indicators. The approaches are illustrated on a hand dishwashing case study.	Get an understanding of the environmental impacts of the various stages of the detergent's life cycle of household manual dishwashing (MDW) detergents.
Study type	LCA	LCA	Screening LCA
Functional Unit	Hand dishwashing 10 plates	Hand dishwashing 14 plates	5 L of wash water
System boundaries	Cradle to grave	Cradle to grave	Cradle to grave: manufacturing, formulation, packaging, transport, use

[90] Van Hoof G, B Buyle, A Kounina, and S Humbert 2013. *Life cycle-based water assessment of a hand dishwashing product: Opportunities and limitations.* Integr Environ Assess Manag, 9: 633–644

[91] Van Hoof G, M Vieira, M Gausman, A Weisbrod 2013. *Indicator selection in life cycle assessment to enable decision making: issues and solutions*. Int. J. LCA. 18(8):1568-1580

[92] AISE. 2014. Charter update 2010. ASP substantiation dossier: Household manual dishwashing (MDW) detergents. Version 1 January 2014

Source	Van Hoof et al, 2013 (IEAM)	Van Hoof et al, 2013 (JLCA)	**AISE. 2014** (Charter update 2010. Version 1 January 2014)
			phase, end of life
Time related coverage	Primary data source not specified. Study is from 2013. Secondary data are from Ecoinvent v2.2 (2010).	Primary data source not specified. Study is from 2013. Secondary data are from Ecoinvent v2.2 (2010).	Data collection for relevant LCA parameters in 2011 and 2013
Reliability (data quality, external critical review?)	Peer reviewed scientific article	Peer reviewed scientific article	The ASPs and the substantiation dossier were subject to consultation with Charter member companies and other interested parties (industry/external stakeholders)
Impact assessment	Midpoint: 1. Swiss ecological scarcity (Frischknecht et al. 2006) 2. Blue water consumption (Boulay et al. 2011) 3. Blue water consumption (Pfister et al. 2009) 4. Blue and gray water consumption (Ridoutt and Pfister 2010) 5. Method evaluating blue and green water (Milà-i-Canals et al. 2009) Endpoint: 6. Terrestrial species diversity from blue water consumption (Pfister et al. 2009) 7. Terrestrial species diversity from renewable groundwater consumption (Van Zelm et al. 2011) 8. Aquatic species diversity from thermally polluted water (Verones et al. 2010)	ReCiPe v1.07 1. climate change 2. ozone depletion 3. photochemical oxidant formation 4. particulate matter formation 5. human toxicity 6. terrestrial acidification 7. freshwater eutrophication 8. marine eutrophication 9. terrestrial ecotoxicity 10. freshwater ecotoxicity 11. marine ecotoxicity 12. agricultural land occupation 13. urban land occupation 14. natural land transformation 15. water depletion 16. metal depletion 17. fossil depletion	Method not specified 1. Climate change 2. Ozone depletion 3. Photochemical oxidant formation 4. Particulate matter formation 5. Ionising radiation 6. Terrestrial acidification 7. Eutrophication 8. Agricultural land occupation 9. Urban land occupation 10. Natural land transformation 11. Metal depletion 12. Fossil depletion

Table 29 presents an overview of the comprehensiveness based on the PEF methodology.

Table 29: Evaluation of comprehensiveness based on the PEF methodology

EF impact category	EF impact assessment method	EF impact category indicators	Source	Van Hoof et al, 2013 (IEAM)	Van Hoof et al, 2013 (JLCA)
Climate change	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon	kg CO_2 equivalent	Inter-governmental Panel on Climate Change, 2007	0	+
Ozone depletion	EDIP model based on the ODPs of the World Meteorological Organization (WMO)	kg CFC-11 equivalent	WMO, 1999	0	0
Ecotoxicity for aquatic fresh water	USEtox model	CTUe (Comparative Toxic Unit for ecosystems)	Rosenbaum et al., 2008	0	00
Human toxicity - cancer effects	USEtox model	CTUe (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008	0	0
Human toxicity – non-cancer effects	USEtox model	CTUe (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008	0	0
Particulate matter/ respiratory Inorganics	RiskPoll model	kg PM2.5 equivalent	Humbert, 2009	0	0
Ionising radiation – human health effects	Human Health effect model	kg ^{235}U equivalent (to air)	Dreicer et al., 1995	0	0
Photo-chemical ozone formation	LOTOS-EUROS model	kg NMVOC equivalent	Van Zelm et al., 2008 as applied in ReCiPe	0	0
Acidification	Accumulated Exceedance model	mol H+ eq	Seppälä et al., 2006; Posch et al., 2008	0	0
Eutrophication – terrestrial	Accumulated Exceedance model	mol N eq	Seppälä et al.,2006; Posch et al., 2009	0	0
Eutrophication – aquatic	EUTREND model	fresh water: kg P equivalent marine: kg N equivalent	Struijs et al., 2009 as implemented in ReCiPe	0	0
Resource depletion – water	Swiss Ecoscarcity model	m^3 water use related to local scarcity of water	Frischknecht et al., 2008	+ Frischknecht et al. 2006	- (Ecoinvent datasets, water depletion (m^3) but no degradative use and depletion potential)
Resource depletion – mineral fossil	CML2002 model	kg antimony (Sb) equivalent	van Oers et al., 2002	0	- (ReCiPe, kg oil eq. based on their heat content)
Land trans-formation	Soil Organic Matter (SOM) model	Kg (deficit)	Milà i Canals et al., 2007	0	0

EF impact category	EF impact assessment method	EF impact category indicators	Source	Van Hoof et al, 2013 (IEAM)	Van Hoof et al, 2013 (JLCA)
Energy consumption	Not applied	Decrease in energy available		0	0
The number of environmental impact categories that are investigated within the studies				1	3
The number of impact categories that are the same as PEF but don't use the same methodology				1	2
The number of impact categories compliant with the PEF methodology, i.e. use the same methodology				1	1

N.B. the AISE study has been left out of this table as the exact method was not specified
+ = compliant with the requirements of the PEF methodology
- = not compliant with the requirements of the PEF methodology
0 = not taken into account
1. Although a 100 year time horizon is not explicitly mentioned, we assume that GWP100 is investigated
2. Characterisation model not explicitly mentioned

3.2.3 LCA review: results

Van Hoof et al.[88] evaluated a single formula with the same global supply chain, manufactured in one location but used in either Spain or Germany – two locations with different water scarcity conditions. This study looked at the opportunities and limitations of life-cycle based water assessment using hand dishwashing detergents as a case study. They used different assessment methods to identify improvement opportunities for HDD products and related LCA database and methods. The study showed differences ranging up to 4 orders of magnitude for indicators with similar units associated with different water use types (inventory methods) and different cause–effect chain models (midpoint and endpoint impact categories). For the inventory methods, the water inventory category results with turbined water use were about 4 orders of magnitude higher compared to the category with green water consumption. Similar differences were observed between midpoint results (4 orders for those with similar units) and the endpoint results (3 orders of magnitude). Without uncertainty information, these differences are associated with the different water use types (inventory categories) or cause–effect chains modelled (midpoints and endpoints).

Van Hoof et al.[88] concluded that the use stage was the most important life cycle stage for most of the methods evaluated (> 90 %). Depending on the method, either the tap water used in the cleaning process (direct use) or the water use in the background processes associated with electricity production (indirect use) were predominant.

Databases covering a broad spectrum of inventory data with spatially differentiated water use information are notably lacking. Furthermore, there is uncertainty in some impact methods because it is not known whether or not characterization factors should be spatially differentiated. Spatial differentiation may lead to very different results for the product used under exactly the same consumer use conditions, making the interpretation and communication of results difficult.

Table 30: Summary of study by Van Hoof et al.

Item	Observation
Title	Life cycle-based water assessment of a hand dishwashing product: opportunities and limitations
Authors	G van Hoof, B. Buyle, A. Kounina and S. Humbert
Reference and year	Integrated Environmental Assessment and Management, 9, 4 663-644 2013 SETAC
Scope	Comparison of a selection of water assessment methods to be applied to two HDD scenarios
Type of study	Cradle to grave LCA
Functional unit and reference flow	FU: 10 plates RF: 2.4 or 4.8 g of HDD / 10 plates depending on the scenario

Item	Observation
System boundaries	The production of raw materials (both for the product and the packaging), the formulation of raw materials into a HDD formula, the package-making operation, distribution of the packed product, the use of the product by consumers and the final disposal of the packaging as well as the wastewater treatment of the down-the-drain emissions
Assumptions (e.g. allocation)	Geographical scope is the production of the ingredients at eh suppliers manufacturing locations, the manufacturing of the product in London (UK) and the use and end-of-life of HDD product in Germany and Spain. Some assumptions were needed given that the source of some elementary water flows is unspecified in Ecoinvent. In those cases, a conversion factor is defined to quantify how much water from the unspecified source originates from groundwater, lakes, etc. as
Data sources & quality	Primary data: formula and packaging information and specific removal of chemicals in sewage treatment Secondary data: Ecoinvent 2.2 (2010)
Impact assessment **categories/methods**	Three types of methods were analysed. - inventory methods that classified elementary water flows according to their type (origin of water resource, intake water quality, etc) and their use (off-stream, in-stream, consumptive/degradative use) into water inventory categories. - midpoint methods that uses WSI are based on water withdrawal or on water consumption - endpoint methods are focused on the ecosystem quality AoP, reflecting changes in species diversity, expressed as the potentially disappeared fraction of species integrated over space and time. Two type of end-point methods are considered in this study: one that models diversity impacts on aquatic species and other that models diversity impacts on terrestrial plant species. Check **Error! Reference source not found.** for the impact assessment categories considered.
Conclusions (e.g. most important LC phases; drivers to impacts, process or material; improvement options)	Two aspects were highlighted in the results as being of key importance: a) the availability of good data, and b) the spatial differentiation. Regarding spatial differentiation, the results may differ up to 25 % depending on local considerations. For example, in this study the differences were attributed to the differences in the electricity grid, the sourcing of tap-water and the differences in the sewage treatment infrastructure and municipal solid waste treatment. LCA studies show that the use stage is the most important life cycle stage for the majority of the methods evaluated in this study. Interestingly, depending on the method, either the tap-water used in the cleaning process (direct use) or the water used in the background processes associated with electricity production (indirect use) were predominant.
Critical review	Yes

In another study by Van Hoof et al.[89], three different normalization approaches that produce very different ranking of indicators were compared in a hand dishwashing case study. If the results are broken down by their key driving midpoints, the most important impact categories are: fossil depletion, climate change and, to a lesser extent, particulate matter formation and metal depletion. However, if the results are broken down by their midpoint normalisation, the most important impact categories are: freshwater eutrophication, natural land transformation and toxicity indicators (marine and freshwater ecotoxicity and human toxicity). For human toxicity, the indicator is totally independent of the product composition and relates to electricity use for heating water during the use stage. For freshwater toxicity, Van Hoof et al. found that waterborne emissions after sewage treatment are the key driver behind the indicator.

The key driving endpoints (reported per midpoint impact category) are fossil depletion and climate change, followed by particulate matter formation, human toxicity and metal depletion. All other indicators are 2 orders of magnitude or more lower. The study concludes that the most relevant area of protection are resources, closely followed by human health and ecosystems.

Table 31: Summary of study by Van Hoof et al.

Item	Observation
Title	Indicator selection in life cycle assessment to enable decision making: issues and solutions
Authors	G van Hoof, M. Vieira, M Gausman, A. Weisbrod
Reference and year	IJLCA (2013) 18: 1568-1580 study based on data from 2000
Scope	Assessment of the normalization methods to narrow the list of indicators by ranking indicators vs a reference system.
Type of study	Cradle to grave LCA of a HDD product developed by P&G
Functional unit and reference flow	FU: dishwashing 14 plates RE; 4.5 g of HDD
System boundaries	The production of the raw materials (both the product and the packaging), the mixing of raw materials into a HDD formula, the packaging making operation, distribution of the packed product, the use of the product by consumers, and the final disposal of the packaging as well as the waste water treatment of the down-the-drain emissions
Assumptions (e.g. allocation)	All sewage is considered to undergo secondary treatment The geographical scope is Europe
Data sources & quality	Primary data Secondary data: Ecoinvent v2.2 (2010)
Impact assessment **categories/methods**	Simapro using ReCiPe v1.07 Three approaches to apply normalization in a combined midpoint-endpoint method Check **Error! Reference source not found.** for the impact assessment categories considered.
Conclusions (e.g. most important LC phases; drivers to impacts, process or material; improvement options)	LCA is an important tool within a sustainability framework because it is a multi-indicator approach and is relative in nature, allowing the comparison of different improvement options. On the other hand, decision making is made easier when results are presented in a way that is focused on environmentally relevant information using objective criteria to the extent possible. Because there are no means to scientifically define whether an LCA indicator is close to or exceeds a threshold, it is impossible to understand its importance and therefore the discussion about the important indicators becomes a value-based discussion. Normalizing LCA results helps to rank indicators relative to a given existing situation. Therefore, even when indicators are ranked, the fact that a selection is made based on this ranking implies a value choice (usually by assuming they are equally important). Nevertheless, it is judged to be preferable as it starts from the assumption that decision makers strive to improve vs the reference and focus on indicators with high contribution. Applying these findings to the improvement options for HDD, single footprints would not be considered if a multi-indicator approach is the basis for decision making. If decision making is based on objective criteria, weighting (single scores) is not possible. Normalization vs a reference system could be a solution to rank indicators and make decisions on the indicator with high ranking. If product comparison or improvement options would be selected as the basis for decision making, this could lead to situations where products are claimed to be preferable or improved on an environmental attribute which is not meaningful or which is largely overestimated. This is not a sound basis for making claims or communicating benefits/attributes to third parties. If endpoint normalization is selected, fossil fuel and climate change would be those with highest ranking. Fossil fuel and metal depletion and climate change are all related to the heating of water during the use stage. Innovations that lead to products with better performance at low temperature, or saving water use, are therefore expected to lead to meaningful improvements. Products that lead to changing consumer behaviour toward saving water or lower water temperature are a second improvement option. Sourcing HDD raw materials that are less dependent on fossil resources is a third improvement option, but with a lower improvement potential
Critical review	Yes

In the ASP substantiation dossier[90], the LCA by the International Association for Soaps, Detergents and Maintenance Products (AISE) showed that the life cycle stage with the largest contribution to the environmental impact for household manual dishwashing detergents in Europe is the use phase, particularly the energy needed to heat water during manual dishwashing. Furthermore, the concentration of a HDD product was identified as one of the key factors to reduce the environmental impact.

Table 32: Summary of study by ASP

Item	Observation
Title	ASP substantiation dossier: Household manual dishwashing (MDW) detergents.
Authors	Experts of nine companies: Colgate Palmolive, Dalli, Henkel, Jeyes, Luhns, McBride, P&G, Reckitt Benckiser and Unilever
Reference and year	2011-2013
Scope	Household manual dishwashing detergents
Type of study	LCA
Functional unit and reference flow	
System boundaries	Stage of the life cycle process considered were: manufacturing, formulation , packaging, transport, use phase and end-of-life
Assumptions (e.g. allocation)	
Data sources & quality	
Impact assessment categories/methods	The impact categories evaluated were: climate change, ozone depletion, photochemical oxidant formation, ionising radiation, terrestrial acidification, eutrophication, agricultural land occupation, urban land occupation, natural land transformation, metal depletion and fossil depletion.
Conclusions (e.g. most important LC phases; drivers to impacts, process or material; improvement options)	LCA shows for HDD in Europe the use phase has the largest contribution to the environmental impact, particularly the energy needed to heat water during manual dishwashing. Given that manual dishwashing detergents end up as water-borne waste, it is essential that a more sustainable product poses a significantly reduced risk environment. Using the LCA as a starting point, several improvement measures were identified: - determining a maximum dosage of ingredients per job - determining a maximum level of packaging materials per job - setting a minimum level of recycled content in primary and secondary packaging - providing on-pack guidance for the most sustainable product use
Critical review	No

3.2.4 Summary of the findings / Summary of the key environmental impacts for hand dishwasher detergents

Although the scopes and goals of the reviewed LCA studies vary, most of them draw similar conclusions that are summarised in this section. From a life cycle perspective the major environmental impacts associated with hand dishwashing detergents are due to:

- The energy used for heating the washing water during the use stage, which significantly contributes to the energy use impact category. Additionally, energy use has an impact in other categories such as fossil fuel depletion and global warming potential.
- The extraction and processing of raw materials that causes an impact on categories such as mineral depletion, land use and energy use.
- The emissions to the environment (water) after use. The discharge of wastewater has impacts on eutrophication while the impacts due to the end-of-life of packaging materials depend on their possible scenarios.

The reviewed studies identified opportunities for product improvement that can be summarised as follows:

- Detergent compaction, by providing consumers with a maximum dosage and adjusted detergent formulation
- Reduction in dishwashing water temperature and amount of water used by providing on-pack guidance for the most sustainable product use
- Reduction of packaging materials by determining a maximum level of packaging materials per job and setting a minimum level of recycled content in primary and secondary packaging

3.3 Non-LCA impacts

3.3.1 Toxicity to aquatic organisms

Toxicity to aquatic organisms is evaluated using Critical Dilution Volume (CDV). CDV was originally developed as an evaluation criterion for detergent ingredients in the context of the European Eco-label scheme[93,94]. It expresses the substance-specific amount of water needed for dilution to a safe level, and is therefore expressed in L per functional unit (FU). The Detergent Ingredient Database (DID) List, a public source of agreed ecological data for detergent production ingredients, can be used to perform CDV calculations as well as laboratory and *in silica* test results. The outcomes can be considered as a product-based relative assessments, on the basis of a functional unit – dose per wash[95,96].

CDV calculations are based on the dosage, degradation and toxicity of a substance using the formula below:

$$CDV = \sum CDV_i = \sum (((dosage_i \cdot DF_i) / TF_i) \cdot 1000)$$

Where $dosage_i$ is the recommended dosage expressed in g per wash, DF_i is the degradation factor and TF_i is the toxicity factor.

3.3.1.1 Toxicity

Per chemical, a chronic toxicity 'base set' of three species should ideally be collected (fish, crustaceans and algae). The lowest toxicity value of these three values is then used for CDV calculations. The toxicity test results to be used can be expressed as the effect concentration at different percentages of effect, e.g. EC10 or EC50, which is the calculated effect concentration at 10 % or 50 % effect, or LC50, which is the concentration at 50% lethality. Measured effects may be on for example growth rate, immobility or mortality, depending on the test organism.

As there are substances with very small amounts of chronic toxicity data or which only have been tested for acute toxicity, there is a need to distinguish between these and other substances where the toxicity factors are based on more solid grounds. TF is calculated as the lowest value of toxicity test results complemented by a safety factor (SF) that is based on the availability of aquatic toxicity data and ranges from 10 to 10000.

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[93] EU Eco-label 1995. *Commission decision of 25 July 1995 establishing the ecological criteria for the award of the community ecolabel to laundry detergents.* Official J European Communities L217:0014–0030, 95/365/EC

[94] Van Hoof G., D. Schowanel, H. Franceschini, I. Muñoz, 2011. *Ecotoxicity impact assessment of laundry products: a comparison of USEtox and critical dilution volume approaches.* Int J Life Cycle Assess, 16:803–818

[95] DID list (2007) Detergent Ingredient Database (DID list) – 2007 version.
http://ec.europa.eu/environment/ecolabel/ecolabelled_products/categories/did_list_en.htm (accessed 17/12/2010)

[96] DID list Part B (2004) Detergent ingredients database version 30 June 2004.
http://ec.europa.eu/environment/ecolabel/ecolabelled_ products/categories/did_list_en.htm. Accessed 17 Dec 2010

3.3.1.2 Degradation

Degradation of substances in CDV calculations is taken into account through the Degradation Factor which considers the ready biodegradability of a substance[97]. It can take four discreet values ranging from 0.05, if an ingredient is degraded in under 5 days, to 1, if an ingredient is persistent in the environment. An exceptional 5th value, 0.01, was introduced in the 2014 version of the DID list that is only assigned to very toxic substances that degrade extremely rapidly.

DF only considers biodegradation and not adsorption. This choice was made in the scope of the EU Ecolabel as adsorpted substances end up in sludge and the presence of harmful substances in sludge can cause problems when the sludge is used as a fertilizer.

3.3.1.3 DID list

The DID-list is a public tool containing toxicity and degradation information on over 200 commonly used ingredients in detergents and cosmetics. The DID list is revised on regular basis to update existing entries and introduce new ones, based on input from industry, competent bodies and ecotoxicology specialists.[Error! Bookmark not defined.] The list is meant to facilitate the work of companies applying for EU Ecolabel and that of competent bodies reviewing applications. Besides listing input data for CDV calculations, it also provides companies, especially SMEs, with an easy way of comparing and ranking ingredients, making it possible for them to spot a possible substitution that would result in a less impacting product.

Error! Reference source not found. shows an example of the information available for common detergent ingredients in the DID-list.

Table 33: Toxicity values and degradation data for example detergent ingredients in the DID-list 98

DID number	Ingredient name	Acute toxicity			Chronic toxicity			Degradation		
		LC50 / EC50	SF (acute)	TF (acute)	NOEC	SF (chronic)	TF (chronic)	DF	Aerobic	Anaerobic
DID category: Cationic surfactants										
2301	C8-16 alkyltrimethyl or benzyldimethyl quaternary ammonium salts	0,08	1000	0,00008	0,0068	10	0,00068	0,05	R	O
DID category: Other ingredient										
	Surfactants									
2505	Zeolite (Insoluble Inorganic)	100	1000	0,1	100	50	2	1	NA	NA
	Builders									
2507	Polycarboxylates homopolymer of acrylic acid	40	1000	0,04	12	10	1,2	1	P	N
2508	Polycarboxylates copolymer of acrylic/maleic acid	100	1000	0,1	5,8	10	0,58	1	P	N
	Bleachers									
2525	Perborates (as Boron)	14	1000	0,014			0,014	1	NA	NA
2526	Percarbonate	4,9	1000	0,0049	0,7	50	0,014	0,01	NA	NA

[97] OECD Ready Biodegradability test - http://www.oecd-ilibrary.org/environment/test-no-301-ready-biodegradability_9789264070349-en

[98] Detergents Ingredients Database (DID-list) Part A. List of ingredients 2014

	Auxiliaries									
2533	Carboxymethylcellulose (CMC)	250	5000	0,05			0,05	0,5	I	N

R = Readily biodegradable according to OECD guidelines, I = Inherently biodegradable according to OECD guidelines, P = Persistent. The ingredient has failed the test for inherent biodegradability, 0 = The ingredient has not been tested, NA = Not applicable, N = Not biodegradable under anaerobic conditions

3.3.2 Risk assessment of chemical release

The emissions occurring during the life cycle of HDDs may have negative health effects on humans and ecosystems. Air emissions occur primarily during the ingredients sourcing and use. The emissions are directly correlated to the energy generation from fossil fuels, and therefore proportionally related to the amount of energy required in the use phase. The energy source plays a role in the environmental impacts; the lower the fossil fuel share in the national mix, the lower the impacts of the overall life cycle.

3.3.3 Sustainable sourcing

In order to protect nature, sourcing of ingredients for HDDs and their packaging materials should be done in a sustainable way i.e. one which takes into account the consequences for the environment (e.g. ensuring that adverse effects on biodiversity are minimised and positive contributions are made where possible).[99]

3.4 In-house LCA studies

Due to the scarcity of publicly available studies on the environmental performance of HDD, in-house LCA analyses were carried out in this study. This section describes the methodology followed, the sources and assumptions considered as well as the obtained results and their interpretation and discussion.

3.4.1 Methodology

The technical analysis was performed using an LCA approach and taking into account the '*Product Environmental Footprint. General Guide*'.[100] The LCA allowed assessing the relative environmental load of each life cycle stage to have an overall profile of the products' performance. Moreover, several comparative analyses and sensitivity analyses were performed regarding: the application of detergent (full sink versus direct application), the amount of warm water, the origin of the surfactant, the dosage of the product, the electricity mix, and the impact method to assess their importance and associated improvement potentials. The LCAs were performed in accordance with the standard methodology of ISO 14040 and 14044 (see Figure 9). The four steps presented in Figure 9 were carried out in an iterative process.

[99] http://www.unilever.com/sustainable-living-2014/reducing-environmental-impact/sustainable-sourcing/protecting-biodiversity/index.aspx

[100] Product Environmental Footprint (PEF) Guide. Official Journal of the European Union (2013/179/EU). Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013H0179

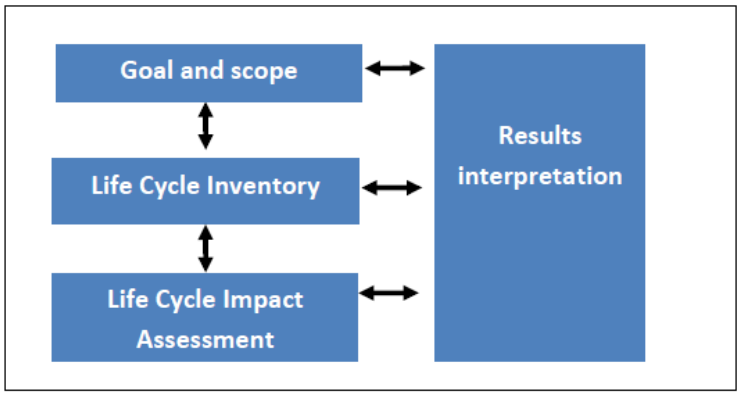

Figure 9: Steps of a life cycle assessment, according to UNE-EN ISO 14040: 2006

3.4.2 Goal definition

Goal definition is the first step of an LCA study. It defines the general context for the study. In the goal definition, parameters such as the intended application, the reasons for carrying out the study, the target audience, the limitations and assumptions have to be described.

The goal of this analysis is to quantify the *potential environmental impacts of products included in the category 'hand dishwashing detergents' during all their life cycle phases*. This analysis does not aim to do a comparison among different products or brands. The main objective is to analyse the impact of each life stage and its contribution in relation to other stages and the global environmental load of the product. Thus, even though a specific product is taken, the study only aims to analyse the performance of an average product manufactured in Europe. Consequently, a general LCA has been performed in order to have the complete environmental profile of the selected product.

Potential environmental improvements of the product have been assessed by analysing different scenarios and sensitivity tests. The goal of this comparison is to *quantify the potential improvement of the environmental performance of this product*.

3.4.3 Scope of the study

The scope of an LCA study consists of describing the system to be analysed along with the associated considerations and specifications. In the study proposed, an LCA from cradle to grave is considered and the following phases are considered, as shown in Figure 10: sourcing of the ingredients and raw material for packaging, manufacture of detergent, product packing, distribution to retail, use phase and disposal/end of life treatment.

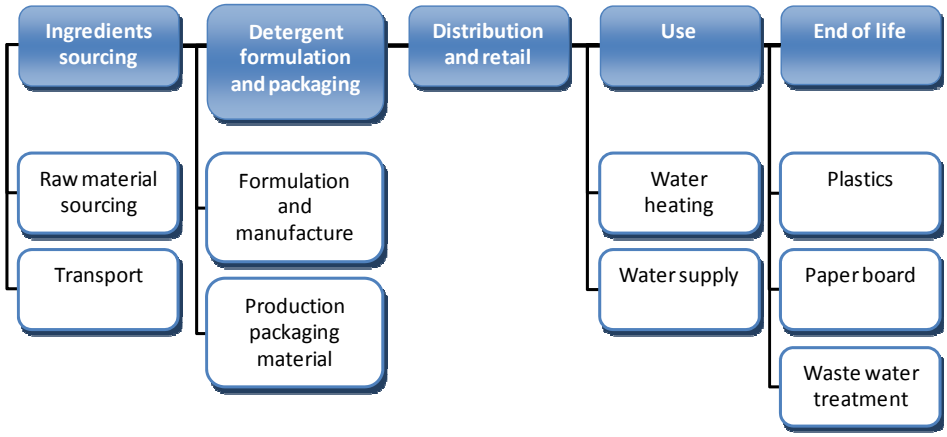

Figure 10: *Schematic representation of the life cycle of a HDD.*

3.4.4 Functional unit and reference flow

The *functional unit* describes qualitatively and quantitatively the function(s) or the service(s) provided by the product analysed. The functional unit is used to define what the LCA is measuring, and provides a reference to which the inputs and outputs can be related. In this case the functional unit chosen is the manual washing of four 'place settings'.[85,87] Place setting specifications are provided in Annex VI.

The *reference flow* describes the amount of the product required to fulfil the functional unit. The reference flows are as follows:

- 8 ml of manual dishwashing detergent based on a '*Full Sink'* scenario (or 2 ml/place setting).
- 12 ml of manual dishwashing detergent based on '*Direct Application'* scenario (or 3 ml/place setting).

The full sink scenario consists in filling up the sink first with water and then washing the dishes but not rinsing. The direct application scenario involves letting the tap run while washing/rinsing, for at least part of the time. In both scenarios drying of the place settings (typically manually or air-drying) was excluded. The reference flow is an estimate based on the review of the existing literature and is not based on the performance of a specific HDD.

3.4.5 System description and boundaries

The **system boundaries** were defined following general supply-chain logic including: raw materials (including raw materials extraction and ingredients manufacturing), manufacturing, packaging, distribution, use and final disposal.

- **Raw materials:** In this sub-system raw materials and processing of ingredients are included. Composition and formulation of these products have been analysed taking into account are: origin of substances (e.g. vegetal, petroleum), production processes (energy and resources used) of substances and the performance of substances (toxicity properties to assess potential environmental impacts). Transport processes have been not considered due to lack of data.
- **Manufacturing:** Standard processes and technologies to manufacture the studied products have been analysed. The use of energy and water during manufacturing is reported, together with waste generation and emissions to air and water.
- **Packaging:** Primary and secondary packaging have been analysed. Some relevant aspects are: weight of material, origin of materials, recyclability. A common packaging has been considered for dishwashing detergents.
- **Transport/Distribution:** The average distribution of products in the European market has been analysed, consisting of the transport from the plant to the final point of sale, including transport among intermediate storage points. Storage processes in the manufacturing plant and intermediary storage have not been included in the system. Transport from retail to consumer homes was omitted. Data were not available, although studies for other categories show that these impacts are generally minimal when compared to other activities.
- **Use:** During use it is important to investigate whether there is a risk that the product may have negative health impacts exists. The potential for negative health impacts could be reduced by increasing the health requirements of hazardous detergents compounds. LCA results do not reflect these effects in the use phase (either due to generic use of data or because the inputs are 'diluted' with the inclusion of all the LCA inputs); these effects are discussed in Section 4.4. In the use phase the environmental impacts associated with the washing of four place settings includes the amount of water used for an average load and the energy to heat the water.
- **Disposal:** Two kinds of 'waste' were included in the system:
    - Disposal of the product into water after use phase: as products studied are rinsed off, it is considered that the whole product is released to wastewater after washing action and subsequently the wastewater is purified in a wastewater treatment plant.
    - Disposal of the packaging: a scenario has been defined for each kind of packaging where a part is recycled and the other goes to disposal. Impacts from recycling have been included in the system boundaries but balanced with environmental benefits occurring due to avoidance of the use of virgin materials (LCA processes pre-defined products life cycles allocation rule). All impacts coming from waste disposal are included in the system.

3.5 Life cycle inventory

Life cycle inventory (LCI) is a 'cradle to grave' accounting of the environmentally significant inputs and outputs of the system. The inventory involves the compilation and quantification of the inputs (materials and resources) and outputs for the product system throughout its life cycle (see Figure 11). The environmental burdens measured in this case study include material input requirements, total energy consumed, emissions released to air and water, and total solid wastes associated with the product's life-cycle. LCI data is normalized with respect to the study's functional unit.

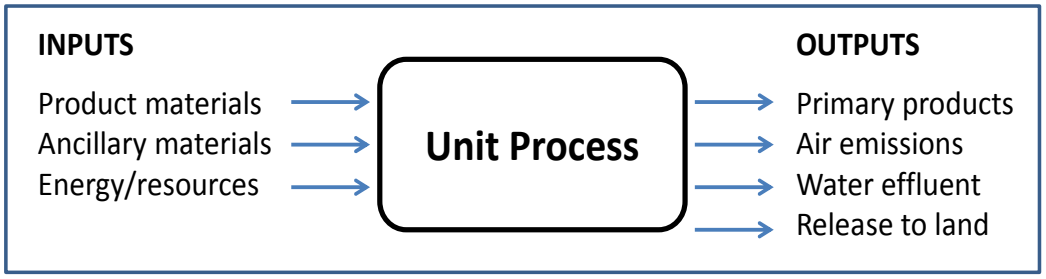

Figure 11: Inventory inputs and outputs

For each sub-system defined, the inputs and outputs of the processes have been gathered and quantified. For the most important stages, primary data (information gathered from products) have been used when possible. For secondary data other studies and existing databases (such as Ecoinvent) have been used. For a few stages which are not considered of high relevance (because they do not depend on the product characteristics) such as distribution or use phase, generic data from other studies were also used.

Table 34: Key assumptions

	Reference	Full sink	Direct application
Functional unit	Assumption	4 place settings*	
Reference flow	Based on Stamminger et al. (2007)[85,87]	8 ml	12 ml
Raw materials and ingredients	AISE	Standard formulation – see Table 35	
Transport ingredients to product manufacturing site	Assumption	Renewable part in surfactants 8000 km (boat) Other ingredients 2000 km (lorry)	
Energy to process raw materials	Koehler & Wildbolz (2009)[101]	3.2 MJ per kg of chemical end product	
Packaging (primary / secondary)	Van Hoof et al. (2013)[89]	Primary pack: 650 ml PET bottle (36.5 g PET bottle, 3.8 g PP cap, 0.9g PE label) Transport packaging: 16 bottles per case (26.3 g of LDPE, 411 g of cardboard)	
Transport retail	Frischknecht and Jungbluth (2002)[104]	100 km by truck and 600 km by train	
Water consumption	Stamminger et al. (2007)[85,87]	7.5 l	15 l
Energy for water heating**	Assumption based on Koehler & Wildbolz	0.05 kWh	0.11 KWh
Energy source for water heating	Assumption	Electricity	
Waste water treatment	Based on EU Statistics	100 % connection to secondary treatment	
Recycling rates solid waste	Eurostat (2012)[105]	Paper & board 83.2 %, Plastic 31.9 %	
Solid waste treatment	Eurostat (2012)[105]	Landfill 65.3 %, Incineration 34.7 %	

* One family meal

** The water temperature is based on the maximum temperature people can stand comfortably with bare hands (40 ˚C). This value is higher for direct application since there is twice as much warm water used.

[101] Koehler A and C Wildbolz, 2009. Comparing the Environmental Footprints of Home-Care and Personal-Hygiene Products: The Relevance of Different Life cycle Phases. ES&T 43(22):8643-8651

3.5.1 Raw materials and ingredients manufacturing

There is no 'generic ' HDD formulation. A large number of different ingredients can be used in a variety of combinations giving rise to different detergent formulations. Generally however, all HDDs contain the following categories of ingredients but in different concentrations: water, surfactants, builders, solvents and additives. Thus, given the different possible formulations, assessing the environmental impact of all varieties of detergents is impractical and a representative product is needed. The generic formulation of a dishwashing detergent as shown in Table 35 was provided by AISE.

Table 35: General formula of liquid HDD[102,103]

General formula of liquid HDD	Concentration (wt %)	Assumption on concentration (wt %)
Softened water	83-85 %	84
Ethanol denaturated	< 0.1 %	0.05
Phenoxyethanol	< 1 %	0.5
Propylene Glycol	< 0.1 %	0.05
Surfactant system (anionic – non-ionic)*	10-17 %	13.85
NaOH	< 0.2 %	0.1
NaCl	< 2 %	0.1
Perfume	<0.5 %	0.25
Dye (2 types)	< 0.1 %	0.05
Preservatives	< 0.1 %	0.05

Table 36 shows the inventory data used to model the generic HDD.

Table 36: Ecoinvent data inventory for a HDD frame formula

Dishwashing product formulation	Assumption on concentration (wt %)	Ecoinvent data
Softened Water	84	RER: water, completely softened, at plant
Ethanol denaturated	0.05	RER: ethanol from ethylene, at plant
Phenoxyethanol	0.5	RER: ethylene glycol, at plant
Propylene Glycol	0.05	RER: propylene glycol, at plant
Surfactant system (anionic – non-ionic)*	13.85	RER: ethoxylated alcohols*
NaOH	0.1	RER: sodium hydroxide, 50 % in H_2O, production mix, at plant
NaCl	0.1	RER: sodium chloride, powder, at plant
Perfume	0.25	Empty process
Dye (2 types)	0.05	Empty process
Preservatives	0.05	Empty process

* Alcohol ethoxylates (AE) with two degrees of ethoxylation AE3 and AE7, 1/6 mix of petrochemical, palm kernel oil, coconut oil

Ingredients of HDDs contain very specific substances. No proxies were available for dye, perfume and preservatives so these were modelled as empty processes.[104]

[102] Vollebregt, L., P. van Broekhuizen, 1994. Tussen wasmand en afdruiprek. Amsterdam: Chemiewinkel Universiteit van Amsterdam (UvA).
[103] Prud'homme de Lodder L.C.H., H.J. Bremmer, J.G.M. van Engelen, 2006. Cleaning Products Fact Sheet to assess the risks for the consumer. Bilthoven, The Netherlands: National Institute for Public Health and the Environment (RIVM). Report no.320104003
[104] There are no data available and 'empty process'; it is essentially an empty field, but it is modelled to keep the percentages correct.

3.5.2 Manufacturing

This module contains energy inputs for the manufacturing of an HDD. As described in Section 4.1.2, the manufacturing process employed for HDD generally consists of mixing and pumping the ingredients into mixing vessels. The exact process employed will depend on the manufacturer and the format of the final product. For manufacturing HDD, the amount of energy used was set to 3.2 MJ per kg of chemical end product, based on a study by Koehler and Wildbolz.[99] It was assumed to be all electricity.[105] The average EU energy mix from Ecoinvent database 2.2 was used. It was also assumed that the detergent and the subsequent packaging are produced at the same location. In the life cycle assessment, the required ingredients, packaging and transport are combined under the assembly of the HDD. Production of waste and emissions for the production of a HDD was not included due to lack of data. Infrastructure was also included.

3.5.3 Packaging

Packaging can be defined as the materials used for the containment, protection, handling, delivery, and presentation of goods. Packaging can be divided into three broad categories:

- Primary packaging is the wrapping or containers handled by the consumer.
- Secondary packaging is the term used to describe larger cases or boxes that are used to group quantities of primary packaged goods for distribution and for display in shops.
- Transit packaging refers to the wooden pallets, board and plastic wrapping and containers that are used to collate the groups into larger loads for transport, which facilitates loading and unloading of goods.

In this study, primary and secondary packaging was included, based on Van Hoof et al.[89] Printing ink for the labels and pallets were excluded, as well as the electricity for the bottle blowing process, because this information is not publicly available. Table 37 shows the inventory data used for the packaging materials.

Table 37: Primary & secondary packaging for a HDD

Packaging (Primary and Secondary)	Ecoinvent data
Primary pack: 650 ml PET bottle - 36.5 g PET bottle - 3.8 g PP cap - 0.9g PE label	 Polyethylene terephthalate, granulate, bottle grade, at plant/RER S Polypropylene, granulate, at plant/RER S Polyethylene, LDPE, granulate, at plant/RER S
Transport packaging: 16 bottles per case - 26.3 g of LDPE - 411 g of cardboard	 Polyethylene, LDPE, granulate, at plant/RER S Packaging, corrugated board, mixed fibre, single wall, at plant/RER S

*2.53E-03 kg of LDPE per kg of product and 3.95E-2 kg cardboard per kg of product, based on Koehler and Wildbolz**Error! Bookmark not defined.**

3.5.4 Transport/distribution

Transport of raw materials was assumed to be 8,000 km (boat) for the renewable part in surfactants, and 2,000 km (lorry) for other ingredients. The ingredients were assumed to come from Asia, hence the large distance. However, it should be noted that transport does not contribute much to the life cycle impacts.

For the distribution phase, literature data has been used to estimate the transport distance. Normally in the European market products are distributed via lorry first to an intermediate storage, then to the storage facilities of direct customers (retailer) and from there to the point of sale (e.g. supermarket). Transport from retail to consumer homes was omitted. Data were unavailable, although studies for other categories show that

[105] This study assumes that the detergent sector buys electricity of the grid, as no other information could have been collected.

these impacts are generally minimal when compared to other activities (based on Frischknecht & Jungbluth (2002)[106]). The distance was set to 100 km by truck (> 16 tonnes, fleet average) and 600 km by freight train.

3.5.5 Use

Data on HDDs, including choices in study assumptions and consumer use, were based on the papers from Stamminger (2007).[85,87] Table 34 shows the key assumptions used in the study. A sensitivity analysis was carried out on variables that have a large contribution on the environmental impact.

3.5.6 Disposal

In this study the 'recycled content method' was applied, meaning that the benefits and burdens associated with recycling and energy recovery from incineration fall outside the scope of the study. The recycling rates for paper and board and plastic were taken from Eurostat (2012).[107] The remaining waste that is sent to landfill and incinerated is allocated to the HDD.

3.5.7 Data quality

For this study generic available data from the Ecoinvent database and agri-food print database were used. This paragraph describes the quality of the available data in these databases, assessed on criteria such as the geographical scale, time-related coverage of data, comprehensiveness and robustness.

Data quality concerning the ingredients is fair. For some ingredients for which no information was available, proxies were used as a best guess. Data for electricity and production is quite good. Data for waste water treatment is fair, but waste water treatment does not contribute much to the life cycle impacts. Typical municipal waste water treatment data was used. For the use phase, which dominates the impact, data quality is good.

3.5.8 Life cycle impact assessment

This section presents the life cycle impact assessment (LCIA). It is based on the data obtained in the inventory stage and includes the analysis of alternative substances for different products.

3.5.8.1 Impact assessment method used

The impact assessment method used was ReCiPe.[108] ReCiPe proposes a feasible implementation of a combined midpoint categories (expressed in units of a reference substance) and damage approach, linking all types of LCI results (elementary flows and other interventions) via midpoint categories to four damage categories: human health, ecosystem quality, climate change, and resources.

Normalization can be performed either at midpoint or at damage level. Midpoints are used for a more specific and detailed analysis, whereas damage endpoints are useful to communicate the results obtained to a broader audience. The pre-defined (mathematical) weighting of the different midpoint score within the ReCiPe assessment method allow us to come to a single score. However, as previously mentioned, this should be used more for communication than for analysis, as weighting is not standardised and it is generally considered more relevant for the experts groups to hold discussions in greater detail – on midpoints level.

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[106] Frischknecht, R., and Jungbluth, N.(2002). Working paper: Qualitiy guidelines ecoinvent 2000 (in German: Arbeitspapier: Qualitätsrichtlinien ecoinvent 2000). Swiss Centre for Life Cycle Inventories, ecoinvent Center: Duebendorf, Switzerland. Retrieved 10.12.2010, from http://www.ecoinvent.org/fileadmin/documents/en/presentation_papers/Qualitaet_5.7.pdf.

[107] Eurostat. (2012). EU Packaging recycling 2005. Retrieved from http://epp.eurostat.ec.europa.eu

[108] Goedkoop, M., Heijungs, R., Huijbregts, M., De Schryver, A., Struijs, J., & Van Zelm, R. (2009). ReCiPe 2009. A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level. The Hague, The Netherlands: VROM.

3.5.8.2 Contribution analysis by life cycle stage

The life cycle stages with the highest contribution to the environmental impacts were identified using characterised midpoint results from ReCiPe. The list of the impact categories, their abbreviations and the results for a HDD are shown in Table 38 and Figure 12. For more information please see Annex V. Please refer to Table 38 below for the abbreviations.

Ingredients: The ingredients are quite an important contributor for the characterised midpoint results, particularly for the categories Terrestrial Ecotoxicity (92 %), Agricultural Land Occupation (51 %) and Natural Land Transformation (80 %). Of all ingredients, the major part of the environmental impact is caused by the surfactant ethoxylated alcohol. The surfactant is of a mixed origin, i.e. both oleo chemical origin (palm and coconut resources) and petrochemical. The oleo chemical origin components in particular contribute to Terrestrial Acidification, Natural Land Transformation and Agricultural Land Occupation.

Manufacturing: The environmental impact of manufacturing relates to the use of electricity to process the raw materials. Manufacturing is quite an important contributor, particularly for Freshwater (35 %) Terrestrial (35 %) and Marine Ecotoxicity (25 %), and Climate Change (23 %).

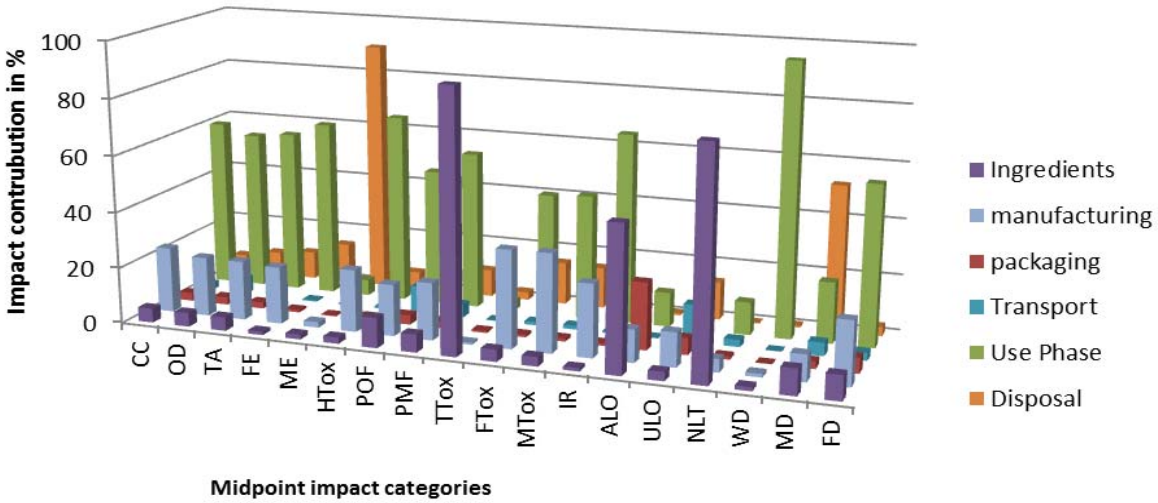

Figure 12: Impact contribution of different life cycle stages of a HDD (See abbreviations in Table 38)

Table 38: Aggregate midpoint results for an HDD

Impact category	Abbreviation	Unit	HDD
Climate Change	CC	kg CO_2 eq	5,74E-02
Ozone Depletion	OD	kg CFC-11 eq	2.99E-09
Terrestrial Acidification	TA	kg SO_2 eq	2,52E-04
Freshwater Eutrophication	FE	kg P eq	5.58E-05
Marine Eutrophication	ME	kg N eq	1.72E-04
Human Toxicity	HTox	kg 1,4-DB eq	3,38E-02
Photochemical Oxidant formation	POF	kg NMVOC	1,53E-04
Particulate Matter Formation	PMF	kg PM10 eq	8,41E-05
Terrestrial Ecotoxicity	TTox	kg 1,4-DB eq	4,43E-05
Freshwater Ecotoxicity	FTox	kg 1,4-DB eq	5,00E-04
Marine Ecotoxicity	MTox	kg 1,4-DB eq	4.89E-04
Ionising Radiation	IR	kg ^{235}U eq	3,95E-02
Agricultural Land Occupation	ALO	m^2a	5,09E-03
Urban Land Occupation	ULO	m^2a	4,21E-04

Natural Land Transformation	NLT	m^2	3,62E-05
Water Depletion	WD	m^3	9,06E-03
Metal Depletion	MD	kg Fe eq	1,73E-03
Fossil Depletion	FD	kg oil eq	1,63E-02

Packaging: This life cycle phase contributes relatively little to the overall environmental impact. The only significant contribution is to Agricultural Land Occupation (24 %). This can be explained by the use of corrugated board for the transport packaging.

Transport: The contribution of transport to the overall environmental impact is the smallest of all the life cycle stages.

Use phase: The use phase is by far the most dominant for most impact categories: Water Depletion (97 %), Human Toxicity (67 %), Ionising Radiation (67 %), Freshwater Eutrophication (63 %), Climate Change (60 %), Ozone Depletion (57 %), Terrestrial Acidification (58 %), Fossil Depletion (56 %), Particulate Matter Formation (56 %), Urban Land Occupation (52 %), Photochemical Oxidant Formation (49 %), Marine Ecotoxicity (44 %), Freshwater Ecotoxicity (44 %). The dominance of the use phase can be attributed to the energy required to heat the water.

End of life: For Marine Eutrophication, the end of life is important and contributes to 90 % of the characterised midpoint results. In particular, waste water sent to the waste water treatment plant (89 %) contributed much to the impact. The end of life is also important for metal depletion (52 %), mainly due to the treatment of waste water.

3.5.8.3 Identification of significant impacts

The magnitude of different environmental impacts cannot be compared to each other because each impact category is expressed in a different unit. It is possible, however, to identify how significant an impact is when compared to a reference - in this case, the average impacts of a European citizen in the year 2000. This step in life cycle impact assessment (LCIA) is known as normalization. The results were calculated based on ReCiPe endpoint[109], using the hierarchist perspective with European normalisation data from the year 2000.[110] The normalised values of the different life cycle stages of an HDD are shown in Figure 13.

[109] Goedkoop, M., Heijungs, R., Huijbregts, M., De Schryver, A., Struijs, J., & Van Zelm, R. (2009). ReCiPe 2009. *A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level*. The Hague, The Netherlands: VROM.

[110] Sleeswijk AW, et al, *Normalization in product life cycle assessment: An LCA of the global and European economic systems in the year 2000*, Sci Total Environ (2007), doi:10.1016/j.scitotenv.2007.09.040

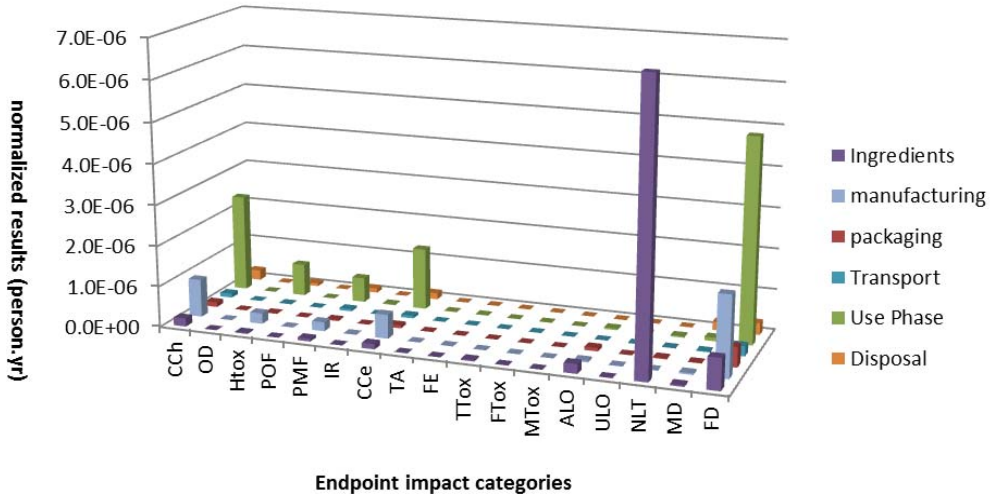

Figure 13: Normalised endpoint results for an HDD (see abbreviations in Table 38)

For an HDD, the most relevant impact category relative to the reference (average impacts of a European citizen in the year 2000) was Natural Land Transformation, followed by Fossil Depletion. The impact for Natural Land Transformation is mainly due to the surfactant: the ethoxylated alcohols. The impacts for Fossil Depletion can mainly be attributed to use of electricity for water heating, manufacturing, blow moulding etc. Climate Change (both for human health and ecosystems), Human Toxicity and Particulate Matter Formation are significant and are also mainly due to the use of electricity.

3.6 Sensitivity analysis

In this section the consequences of the assumptions on the overall results are explored. The following variables were selected for analysis because the contribution analysis showed they had a significant contribution on a particular life cycle phase:

- the application of detergent (full sink versus direct application)
- the amount of warm water
- the temperature of the water
- the origin of the surfactant
- the dosage of the product
- the electricity mix
- the impact method.

The sensitivity analysis focuses on the impact categories which have shown to have the most significant contribution in the normalised endpoint results namely: Natural Land Transformation, Fossil Depletion, Climate Change, Human Toxicity and Particulate Matter Formation.

3.6.1 Full sink versus direct application

As deducted from Stamminger et al., roughly 70 % of consumers wash their dishes in a water bath (sink or bowl) the so-called 'full sink' approach. The remaining 30 % do their washing-up under continuously running tap water – the so-called 'direct application' approach. This sensitivity analysis tested the differences in impact of the 'full sink' and 'direct application' approaches, using the assumptions as shown in Table 39.

Table 39: Assumptions 'full sink' vs 'direct application'

	Full sink	Direct application
Amount HDD	8 ml	12 ml
Water consumption	7.5 l	15 l
Energy for water heating	0.05 kWh	0.11 KWh

As expected, the direct application scenario scores significantly higher on all impact categories (see Figure 14). From this analysis it can be deducted that reducing the amount of detergent, water and energy will lower the environmental impact. The other sensitivity analyses will focus on these elements separately.

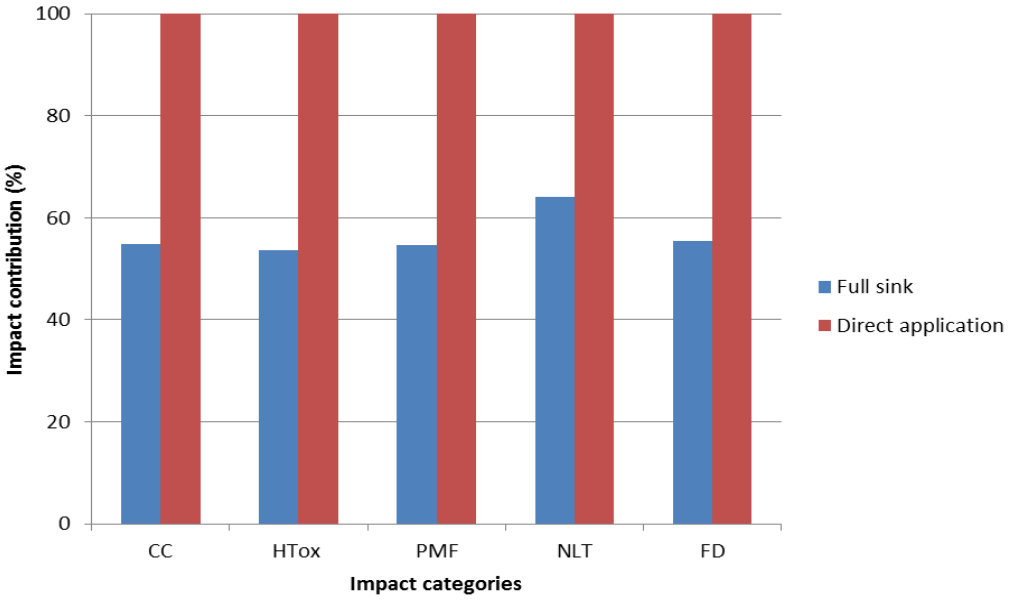

Figure 14: Sensitivity full sink versus direct application (see abbreviations in Table 38)

3.6.2 Amount of warm water

In the use phase, warm water is commonly used to wash and rinse the dishes. In the baseline and in this section, the temperature of the water is assumed to be 40 °C. In the sensitivity analysis, the impact of the amount of warm water for the full sink scenario with 7.5 litres of water (baseline) is compared to twice the baseline amount (15 l), or half the baseline amount (3 l). This latter was kept to check the influence of the amount of warm water in the environmental impacts, but it does not mean that the washing could be done using such a small amount of water.

A change of amount influences all the impact categories as shown in Figure 15. for Fossil Depletion, Climate Change, Human Toxicity and Particulate Matter Formation, a proportional change in the impact was observed. Natural Land Transformation was the only impact category which stayed relatively consistent for the three amounts. This matches expectations, as most of the impact on Natural Land Transformation relates to the use of the ingredient ethoxylated alcohols.

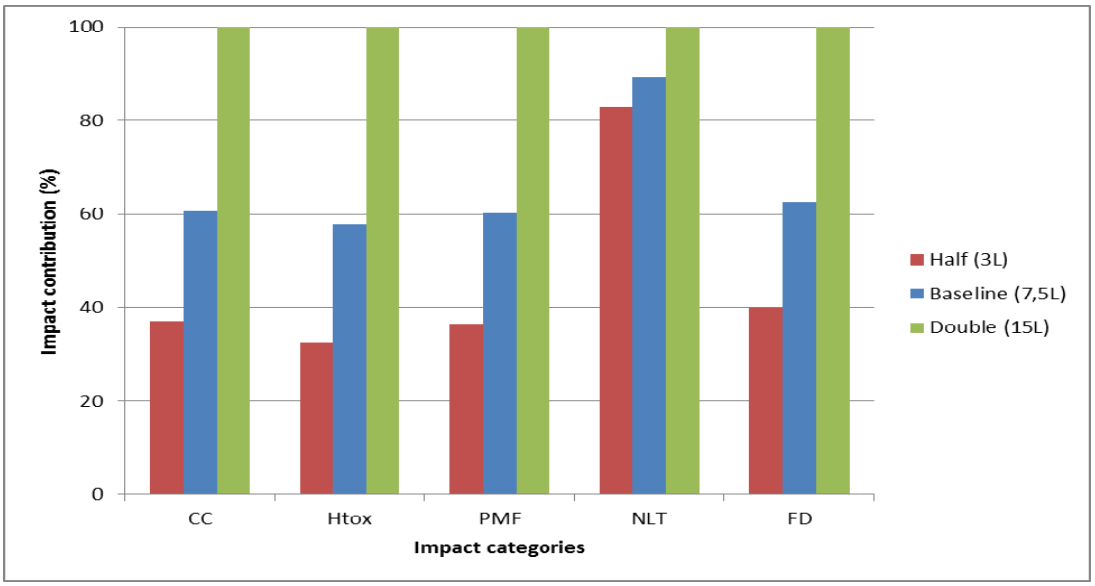

Figure 15: sensitivity to amount of water (See abbreviations in Table 38)

3.6.3 Temperature of the water

In the use phase, warm water is used to wash and rinse the dishes. In the sensitivity analysis, we compared the impact of the temperature of the water for the full sink scenario with 7.5 litres of water of 40 °C (baseline) to cold water 15 °C, water with a temperature of 30 °C and water with a temperature of 60 °C. A higher temperature of the washing water contributes to a proportional increase of all impact categories, as shown in**Error! Reference source not found.**Figure 16. A decrease in the temperature of the washing water therefore results in a proportional decrease in all impact categories. This matches expectations, as heating of the water in the use phase is an important contributor to the overall environmental impact.

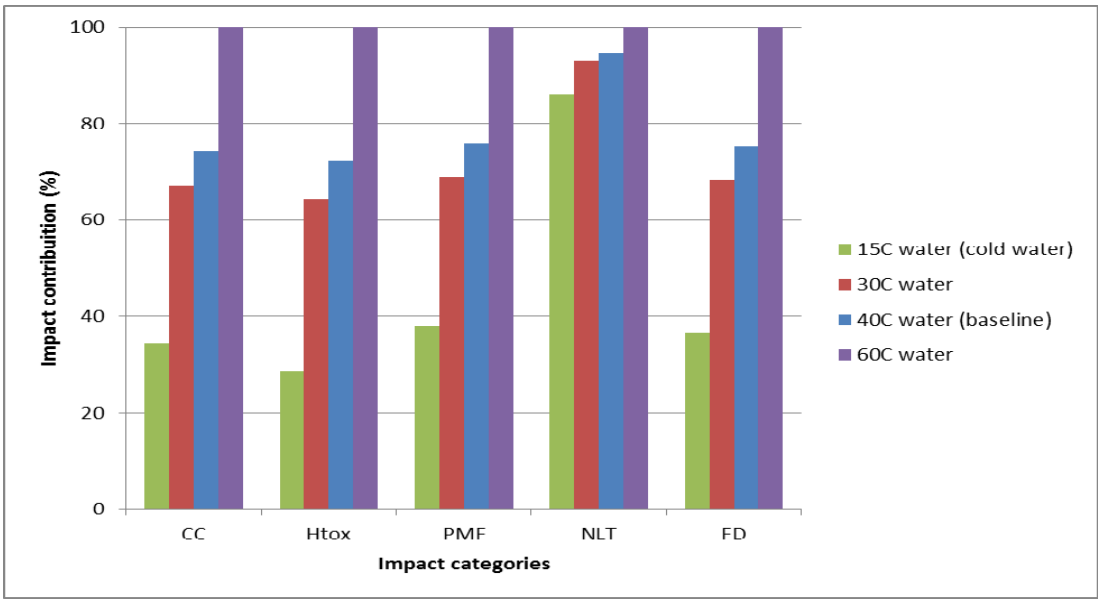

Figure 16: Sensitivity to temperature of water (See abbreviations in Table 38)

3.6.4 Surfactant origin

The surfactant used in detergent can be petroleum-derived or plant-derived from palm oil, palm kernel oil, or coconut oil. In the formulation of HDD, ethoxylated alcohol (AE) with two degrees of ethoxylation AE3 and AE7, 1/6 was used. Here the impact of the origin of the surfactant on the overall environmental impact is analysed.

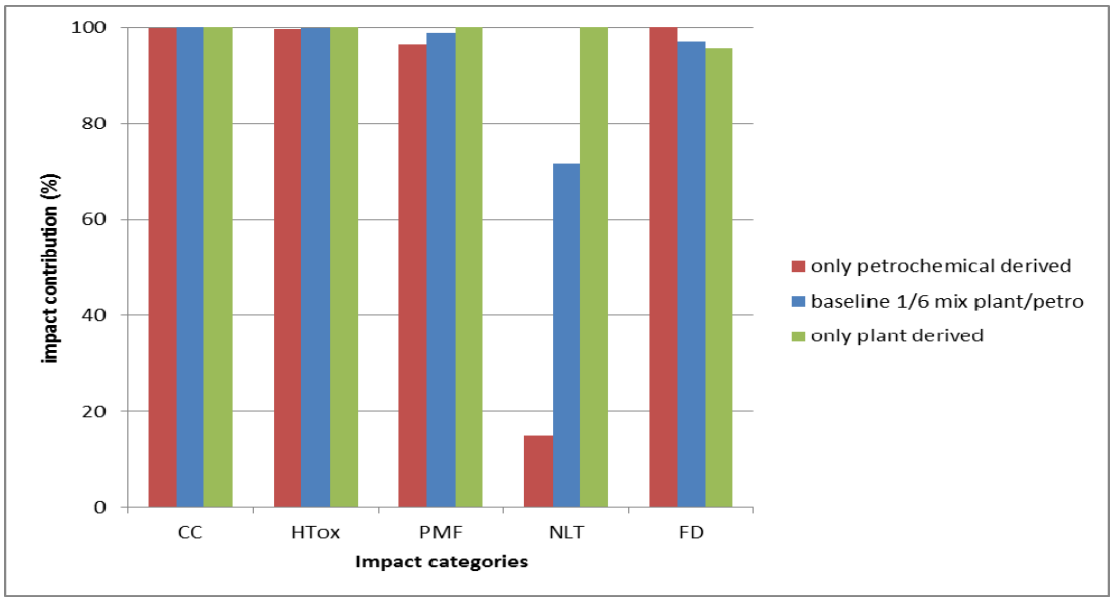

Figure 17: Sensitivity to formulation (See abbreviations in Table 38)

The results show that if a purely plant-derived AE is used for the detergent formulation, the natural land transformation drastically rises. When purely petroleum-derived AE is used for the detergent, the impact on fossil depletion rises. However, the impact is smaller than that of the plant derived AE on natural land transformation. This can be explained by the fact that the impact on Natural Land Transformation comes mainly from the surfactants, whereas for Fossil Depletion electricity is the main contributor.

The LCIs for surfactants, whilst the best available, are over 15 years old and they do not contain adequate data relating to direct land use change. For compliance with WRI GHG protocol, ILCD and ISO 14040/44, any direct land use change occurring in the previous 20 years should be considered for above- and below-ground biomass and for soil organic matter (differentiated for peat and mineral soil).

Consequently the results for impact categories relating to direct land use change and the associated GHG emissions are compromised and hence must be interpreted with caution. The available outdated LCI datasets have been included for completeness and for future comparison with the updated and improved surfactant inventories which have not been published at the time of this revision.

3.6.5 Product dosage

In the 'full sink' baseline scenario, the reference flow is 8 ml of HDD per functional unit. In the sensitivity analysis, we tested the influence of using half a dose or a double dose of HDD. As can be seen in Figure 18, the amount of HDD proportionally relates to all five impact categories. This shows that the amount of HDD influences the environmental performance.

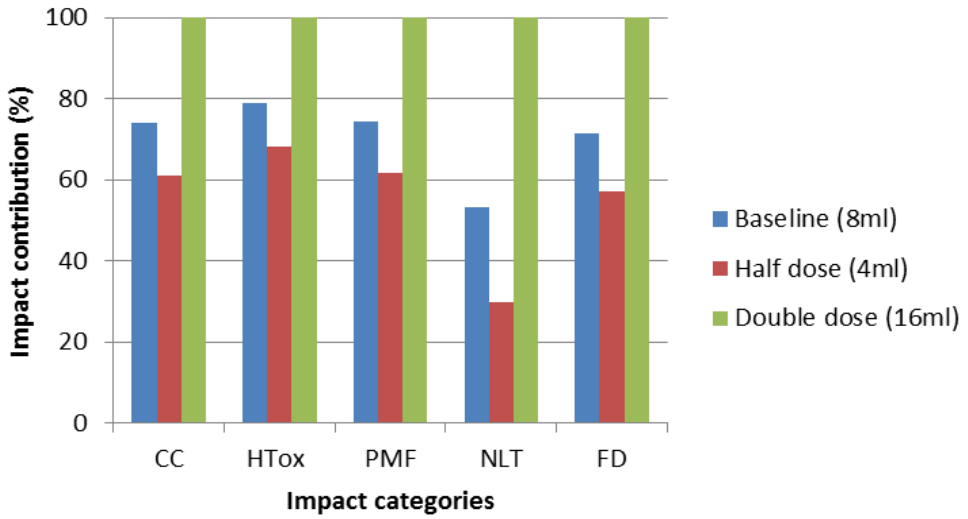

Figure 18: Sensitivity dose HDD (see abbreviations in Table 38)

3.6.6 Electricity mix

In the baseline scenario we used the energy mix for Continental Europe (the Union for the Coordination of the Transmission of Electricity (UCTE)) from Ecoinvent. This represents the electricity net production shares by the member countries based on annual averages from the year 2000. For the sensitivity analysis we used the dataset for electricity production in France (approximately 50 % is derived from nuclear energy), electricity production in Switzerland (approximately 50 % derived from hydropower), and electricity production in the Netherlands (approximately 50 % is derived from natural gas). The results are shown in Figure 19.

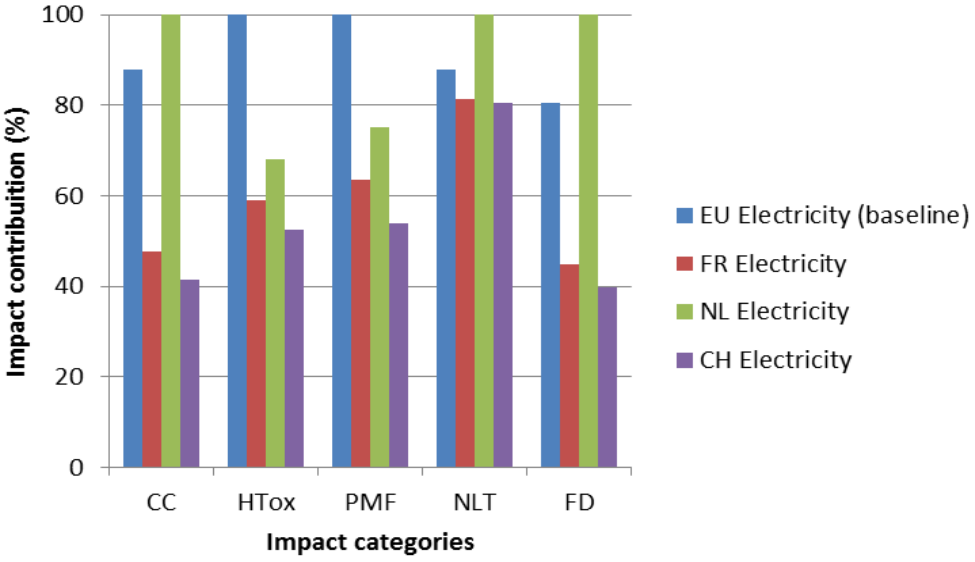

Figure 19: Sensitivity to electricity mix (See abbreviations in Table 38)

The results show that switching to an energy mix based mostly on nuclear energy significantly reduces the environmental impacts in nearly all impact categories, as does switching to an energy mix based mostly on hydro power. This is because these sources are a cleaner source of energy compared to the electricity mix used in the study, which includes coal, crude oil, lignite, etc, which have higher GHG emissions.

Trade-offs occur between other impact categories. Switching to an energy mix based on mostly gas would result in higher environmental impacts for nearly all categories. However, the impact on Particulate Matter Formation and Human Toxicity would be reduced significantly.

The comparison between the four different electricity mixes shows that switching to an electricity mix with higher renewable energy sources share is beneficial from the environmental point of view. Switching towards an electricity mix based on nuclear energy significantly decreases the impact on the selected categories. However, we cannot draw the conclusion that this is environmentally beneficial from a holistic point of view, as it can heavily impact on other non-studied categories.

There is a significant increase in most of the categories under study when the electricity mix is mainly produced from natural gas. Switching to an energy mix based mostly on gas would result in higher environmental impacts for nearly all categories. However, the impact on ionising radiation would be reduced significantly, and the impact on Freshwater Eutrophication and Human Toxicity would also be reduced a little. This fact can be attributed to the larger use of fossil fuel resources

3.6.7 Impact method

Differences in characterization models and their substance coverage for individual impact categories have earlier been identified as influential on the results of LCAs, sometimes able to change the conclusions of comparative LCA studies and often leading to different ranking of substances in terms of their contribution to the environmental impact.[111]

In 2012, following work involving evidence from domain experts and stakeholders, the JRC identified best practice and launched a recommended set of characterization models and factors for application in LCIA.[112] The recommended method, referred to as ILCD 2009, was compiled by assessing a total of 156 different characterization models belonging to 12 different LCIA methodologies and choosing the most appropriate, based on a predefined set of assessment criteria.[113] The ILCD 2009 is now being introduced into LCA modelling tools, but it is not known yet whether there can be differences in impact scores between the ILCD 2009 and other frequently used LCIA methodologies and whether the choices of the ILCD 2009 matter for the implementation of LCA results.

In this study, the results were analysed with the ReCiPe midpoint hierarchist perspective. Here we test the influence of this method choice, by comparing the outcomes to the outcomes of another method: ILCD midpoint (see Figure 20).

According to ILCD, ingredients are less relevant for the overall environmental impact. In ReCiPe ingredients scored highly on categories Terrestrial Ecotoxicity (92 %), Agricultural Land Occupation (51 %) and Natural Land Transformation (80 %); these three impact categories are not included in the ILCD method. For manufacturing, both methods give similar results. Packaging contributes less than 10 % for all impact categories. Agricultural Land Occupation contributed for 24 % in ReCiPe and is not assessed in ILCD. For transport, both methods provided similar scores. In line with ReCiPe, the ILCD method shows that the use phase is the most important contributor for all the characterised midpoint results. The use phase is dominant in all categories, except for Human Toxicity non-cancer effects, Marine Eutrophication and Freshwater Ecotoxicity. Only Freshwater Ecotoxicity (28 %) in ILCD does not score as highly as Freshwater Ecotoxicity (44 %) in ReCiPe. In ReCiPe, impact categories which are less relevant for the use phase are Natural Land Transformation, Metal Depletion and Agricultural Land Occupation, but these are not assessed in ILCD. The end of life contributed to the characterised midpoint results for Marine Eutrophication, Human Toxicity non-cancer, and Mineral, Fossil & Renewable Resource Depletion, according to ILCD. Freshwater Ecotoxicity and Human Toxicity non-cancer are noteworthy, since they scored particularly high in ReCiPe. Metal depletion, which was important in ReCiPe, is not included in ILCD.

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[111] M. Owsianiak, A. Laurent, A. Bjorn, M. Z. Hauschild, IMPACT 2002+, ReCiPe 2008 and ILCDs recommended practice for characterization modelling in LCA: a case study-based comparison. Int J LCA, DOI 10.1007/s11367-014-0708-3

[112] Energy roadmap 2050. ISBN 978-92-79-21798-2

[113] Recommendations based on existing environmental impact assessment models and factors for LCA methods. Databases and supporting information. EUR 25167 http:/let.jrc.ec.europa.eu

Overall both methods show that the use phase is the most important hotspot. It should be noted that ingredients are not indicated as an environmental hotspot in the ILCD method because Terrestrial Ecotoxicity, Agricultural Land Occupation, and Natural Land Transformation are not taken into account in the ILCD. Another point to consider is the relevance of Human Toxicity - non-carcinogenic, which scored high in the end of life according to ILCD and scored relatively low in ReCiPe.

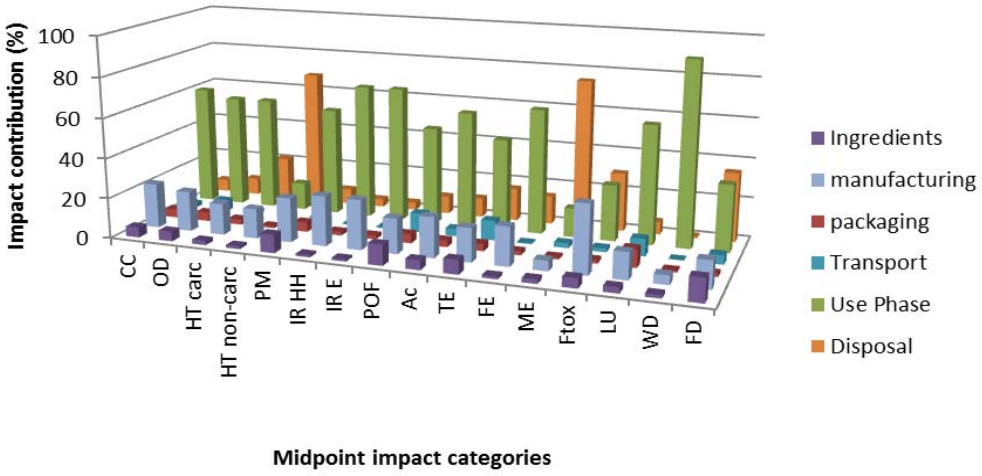

Figure 20: Impact contribution of different life cycle stages of HDD according to the ILCD method

3.6.8 Sensitivity of the surfactant to the database

In the present screening LCA we chose the widely used Ecoinvent database version 2.2 as a reference for the ingredients data. Recently, another LCI database containing data on palm and coconut oil production became available: the Agri-footprint® database.[114] It is important to note that the differences in data collection methods between these databases result in differences in environmental impact of coconut and palm oil when using the ReCiPe endpoint method. Here we compare the results of the two databases on two renewable surfactants: coconut oil and palm kernel oil, which have shown to have a significant contribution to the environmental impact of detergents (see paragraph 4.6.44.6.8), which is to a large extent due to land transformation.

In general, the Agri-footprint database based land transformation data on observed changes of palm fruit or coconut cropland for the past in 20 years in the countries where they are grown. Ecoinvent based its inventory data on permanent transformation of primary forest into agricultural land, and subsequently transformation into forest (planted forest) when the palm trees are not productive anymore, as reported by the farmers.

3.6.8.1 Coconut oil

The Ecoinvent database assumes that for coconut trees, primary forest is permanently transferred into agricultural land. In Agri-footprint it is assumed that coconut area has not increased in the Philippines for the past 20 years, based on observed data. As a result, 1 kg of ethoxylated alcohols from coconut oil in Ecoinvent scores higher on natural land transformation (see Figure 21[115]). Furthermore, the total environmental impact at endpoint level of 1 kg of ethoxylated alcohols from coconut oil is slightly higher in Ecoinvent. This is because the impact from other categories is much higher in case of Agri-footprint, due to different assumptions on yield per hectare and fossil fuel use. As the difference between the total impact of this ingredient is small, Agri-footprint will lead to the same overall conclusion regarding the importance of the surfactants in the life cycle of detergents.

[114] http://www.agri-footprint.com/

[115] Impact categories that are not shown contribute less than 1 %

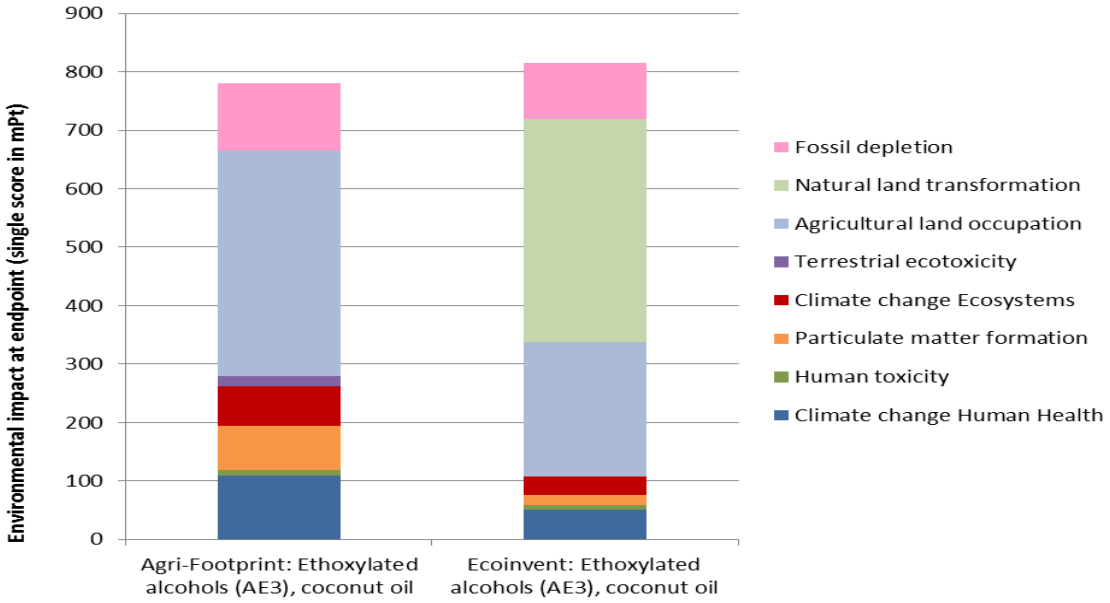

Figure 21: Comparison between the environmental impact at endpoint of 1 kg of ethoxylated alcohols from coconut oil in Ecoinvent and in Agri-Footprint

3.6.8.2 Palm kernel oil

In the Ecoinvent database, the amounts of transformation for of palm kernel oil are based on numbers for tropical forest transformed into palm kernel oil cropland and transformation to forest (planted forest), as reported by the farmers. Conversely, in Agri-footprint the amounts for palm kernel oil are based on data that indicate there was an increase in palm kernel oil cropland in Malaysia in the past 20 years. In Ecoinvent there is more transformation of tropical forest into palm kernel oil cropland, but there is also transformation to forest (not specified as being tropical forest). In Agri-footprint there is less transformation of tropical forest transformed into palm kernel oil cropland, but there is no planting of new forest.[116] This is because the developers of Agri-footprint calculated the net transformation to palm fruit area.

As the characterisation factor for damage at the end point level for transformation from tropical forest is about 30 times higher than the characterisation factor for transformation from forest (and the negative factor for transformation to tropical rain forest is about 30 times higher than for transformation to forest), the higher number for transformation from tropical forest in Ecoinvent leads to a higher impact on Natural Land Transformation for 1 kg of ethoxylated alcohols from palm kernel oil in Ecoinvent (see Figure 22).

Furthermore, the total environmental impact at endpoint level of 1 kg of ethoxylated alcohols from palm kernel oil is higher in Ecoinvent.
The information that is currently available does not give insights in which of the methods lead to more realistic results. However, as natural land transformation is also the most important impact category in our study when using coconut or palm oil from Agri-footprint, just like it is when using Ecoinvent, from the use of Agri-footprint can also be concluded that the surfactants are an important contributor to the life cycle impact of detergents. The magnitude of the impact, however, is variable.

[116] A bug correction in the current version of Agri-Footprint was made for the process oil palm fruit bunch: “Tranformation, from forest” changed into “Transformation, from tropical rain forest”.

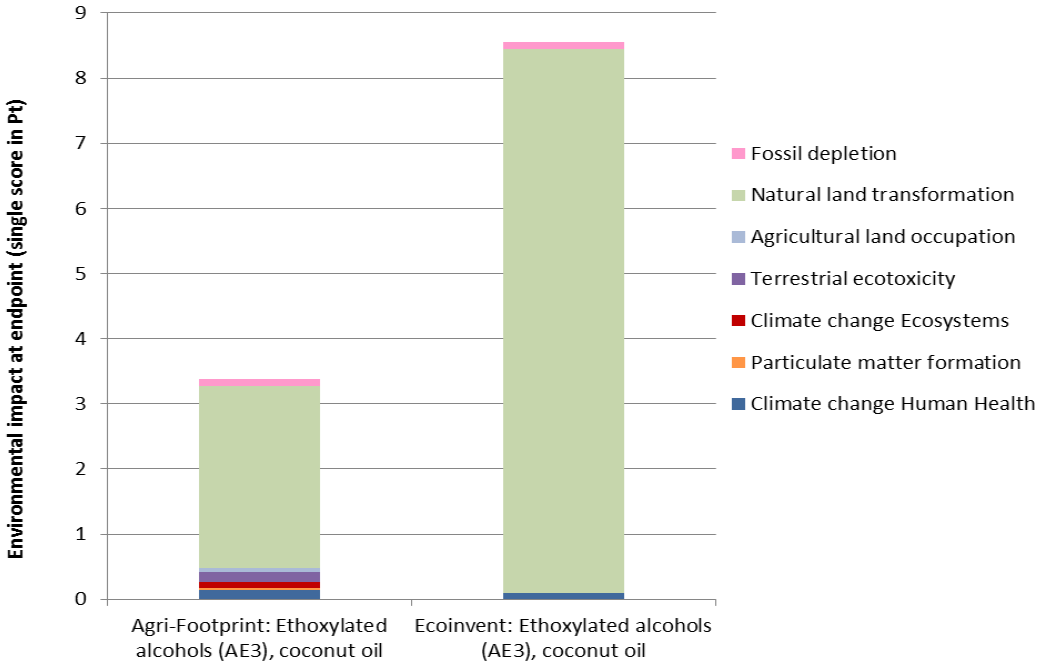

Figure 22: Comparison between the environmental impact at endpoint level of 1 kg of ethoxylated alcohols from palm kernel oil in Ecoinvent and in Agri-Footprint

3.1 Summary of findings

The following conclusions can be derived from the screening LCA:

I. The life cycle stage with the largest contribution to the environmental impact profile of an HDD is, by far, the use phase followed by the sourcing of raw materials (ingredients) and the end of life.

II. Based on the normalisation assessment, the most significant impact categories for HDDs in Europe are Natural Land Transformation and Fossil Depletion.[117]

Based on the results of this study, the key environmental performance indicators (KPIs - i.e. those variables that drive the results) for HDDs in Europe are:

- Amount of product used.
- Formulation, to be specific: the choice and amount of surfactant.
- Energy needed to heat the water.
- Energy source used to heat the water.

The following conclusions can be made about the key environmental considerations that should be linked to the Ecolabel criteria of HDDs, as presented in Table 40:

Table 40: Overall summary of the key environmental considerations linked to the Ecolabel criteria

Conclusion	Significance	Addressable in the EU Ecolabel
The formulation is an important contributor to environmental impact. Surfactants are responsible for most of the impact.	High	Yes, directly by restricting the use of the worst performing surfactants
The use phase is the most significant contributor to the environmental impact, driven by energy needed	High	Somewhat, but indirectly through consumer information criteria

[117] The impact on natural land transformation is due to the use of palm and coconut based surfactants. This is the case for all detergents (laundry, APC, dishwasher etc).

to heat water. Therefore, consumer information on the packaging can be used to tell consumers to use cold water for rinsing to reduce the amount of energy consumed to heat the water.		
An important environmental impact arises from the end of life, specifically related to municipal wastewater treatment.	Medium	Yes, through the toxicity to aquatic organisms criterion
Impacts of detergent packaging are of medium importance.	Medium	Yes, through the packaging requirements criteria
The impacts of distribution and transport are low	Low	No, would require specification for local sourcing

4. PRODUCT INNOVATIONS AND IMPROVEMENT POTENTIAL

4.1 Introduction and approach

The aim of this section of the report is to assess the potential improvement that might be delivered by adopting the revised criteria for the EU Ecolabel for all HDDs.

In order to assess the potential improvement of HDDs the following have been undertaken: a sensitivity analysis using the results from the LCA study; identification of recent product innovations; an estimate of the potential benefits associated and identification of the possible measures to be undertaken in the EU Ecolabel.

The sensitivity analysis conducted using results from the LCA study is presented in Section 4.6 and covers the attributes which showed significant contribution to the environmental impact. These are: the application of detergent (full sink versus direct application), the amount of warm water, surfactant origin, product dosage, the electricity mix, and the impact method.

4.2 HDD product innovations

In order to understand the scope of improvement options for HDD, recent product innovations which led to enhanced performance have been identified. These product innovations are: compaction, low-temperature cleaning performance, low/no harmful chemicals content, natural/renewable ingredients.[118] Each of these innovations and their improvement potential is discussed below. Product innovations have been introduced throughout this report; the focus in this section is on innovations which offer improvement in terms of environmental performance.

4.2.1 Compaction

Compaction is now common amongst the large brands in HDDs, with brands such as Unilever and Procter & Gamble offering products which are at least 2X and often 3X concentrated. However, further innovation in compaction technology has led to the development of 8X concentrated HDD.[119] Compaction of HDDs brings several environmental benefits, through reductions in the amount of ingredients and packaging raw materials used, savings in water, energy and resources are made.

4.2.2 Natural/renewable ingredients

The use of ingredients from natural or renewable sources instead of petrochemical sources is increasing in the HDD market. For most of the bulk ingredients this is not an option as they are inorganic and therefore cannot be easily replaced by renewable raw materials. However, for surfactants it is possible to use raw materials from renewable origins as their lipophilic compound is usually organic. Historically, vegetable and animal oils and fats were used as raw materials for soaps and detergents. Consequently, the use of renewable raw materials in this product group is not a recent innovation.

4.3 Conclusions

A summary of the results from the sensitivity analysis and the LCA analysis for HDD, along with the feedback provided after consultation to the stakeholders and their suggestions for how these issues can be addressed by the EU Ecolabel and an estimate of the potential benefits associated are presented in Table 41. The outcomes are presented by life cycle stage.

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[118] Global Household Care: Green Cleaning – Still an Oxymoron, Euromonitor International, September 2009.
[119] How laundry detergent became a catalyst for green innovation, Yale Environment 360, June 2013. Available from: http://e360.yale.edu/feature/adam_lowry_how_laundry_detergent_became_green_innovation_catalyst/2662/

As the results of the LCA and sensitivity analysis have shown that the highest environmental impacts are associated with the use phase and the ingredients used, the focus for improvement should be for these phases. The high environmental impact of the use phase can be addressed by encouraging consumers to wash at lower temperatures and promoting products which are effective at low temperatures. Moreover, impacts of the use phase could be further reduced with product compaction and the restriction on the content of harmful substances. The sensitivity analysis also showed that dosage is an important aspect, as an increase in product dosage leads to a proportional increase in the overall environmental impact. Overdosing can be addressed by improved consumer awareness through user instructions on the packaging.

Table 41: Outcomes of sensitivity analysis and actions in Ecolabel criteria

Stage	Environmental impact	Potential environmental gain	Good environmental practices/restrictions	Area of improvement
IIngredients	1-92 % impact contribution, the highest indicator score goes for terrestrial ecotoxicity. Also it is important the score for natural land transformation, and agricultural land occupation.	High	For each functional group in the product composition, select substances which are less harmful in terms of ecotoxicity, aquatic toxicity and biodegradability	Improvement of the environmental performance of ingredients used. The sensitivity analysis has shown that for terrestrial ecotoxicity the ethoxylated alcohols have the highest impact. For Human Toxicity, freshwater toxicity and marine ecotoxicity ethoxylated alcohols and ethylene glycol diethyl ether have the highest impacts.
			Restrict the use of surfactants which have a significant impact on natural land transformation and agricultural land occupation.	The sensitivity analysis showed that impact can be reduced by excluding surfactants from coconut oil
Manufac-turing	0-35 % impact contribution, the highest score goes for freshwater and terrestrial eutrophication, marine ecotoxicity and climate change.	Low	Choose a clean source of energy	The sensitivity analysis showed that switching to an energy mix based mostly on hydro power significantly reduces the environmental impacts in nearly all impact categories, except for ozone depletion, ionising radiation, water depletion, and metal depletion.
Packaging	0-24 % impact contribution, 0-6 %contribution of all the indicators except for agricultural land lccupation which accounts for 24 %.	Moderate	Reduce the use of packaging materials from virgin sources by encouraging post-consumer materials for packaging.	As the majority of the environmental impact from packaging is due to the material a decrease in the use of virgin materials will result in direct decrease of environmental impact.
Transport	0-13 % impact contribution, the highest indicator score for photochemical oxidant formation and urban land occupation. Overall the impact is minor compared to the other stages.	Low	Decrease packaging weight and improve transport efficiency and logistics.	Saving of fossil fuel used in transport.

Stage	Environmental impact	Potential environmental gain	Good environmental practices/restrictions	Area of improvement
Use phase	1-97 % impact contribution, Water Depletion, Human Toxicity, Ionising Radiation, Freshwater Eutrophication, Climate Change, Ozone Depletion, Terrestrial Acidification, Fossil Depletion, Particulate Matter Formation, Urban Land Occupation, Photochemical Oxidant Formation, Marine Ecotoxicity, Freshwater Ecotoxicity. The energy used to heat the water is the highest contributor to this.	Moderate – can only be addressed indirectly through recommendations on use.	Clean at lower temperatures. Encourage the use of detergents effective at 30 °C and below.	The sensitivity analysis has shown that reducing the amount of warm water used, or the temperature of the water, would lead to reduced environmental impact, particularly for Fresh Water Eutrophication, Human Toxicity, Freshwater Toxicity Marine Ecotoxicity, Ionising Radiation, Urban Land Occupation, and Water Depletion.
			Do not overdose the product as this increases the overall chemical load.	The sensitivity analysis has shown that by reducing the dose, the environmental impact in all impact categories can be reduced proportionally.
Treatment of packaging waste	0-90 % impact contribution, highest for marine Eutrophication, <52 % for the rest of the impact categories.	Impacts are dependent on the packaging stage	Encourage the use of packaging which is recyclable and easy to disassemble	Recycling or packaging waste is generally environmentally preferable than other waste treatment options.

5. CONCLUSIONS AND FURTHER STEPS

This report presents the research carried out, through stakeholder surveys, market analysis, legal review and an environmental performance investigation, on areas related to the product group covered by the EU Ecolabel on hand dishwashing detergents. The report provides background information that underpins to the revision of the EU Ecolabel criteria and the proposed changes. The rationale behind the changes is included in the accompanying document: "Technical Report"

The main findings of the Preliminary Report are:
- The market analysis reported that the total retail value of the EU market for hand dishwashing detergents is €1.8 bn. Innovation in the hand dishwashing detergents market is relatively limited, and is primarily driven by adding functionality to the product. The range of hand dishwashing detergent products available includes budget variety, premium products and environmentally friendly versions.
- The technical analysis found that the key environmental impacts of hand dishwashing detergents can be summarised as follows:

  The life cycle stage with the largest contribution to the environmental impact profile of hand dishwashing detergents is - by far - the use phase, particularly the energy needed to heat the water. For some impact categories, the sourcing of raw materials and the end of life are also important.

  Based on the normalisation assessment, by far the most important impact categories for hand dishwashing detergents in Europe are natural land transformation and fossil depletion.

The results of the LCA for a hand dishwashing detergent conducted as part of the technical analysis are shown in Figure 23. The ingredients represent an important contribution to characterised midpoint results, in particular for terrestrial ecotoxicity, agricultural land occupation and natural land transformation. Of all the ingredients, the surfactant ethoxylated alcohol accounts for the largest contribution to these impact categories. However, the use phase is by far the most dominant for the impact categories. The manufacturing and disposal phases are also important contributors to the freshwater, terrestrial and marine ecotoxicity impact categories.

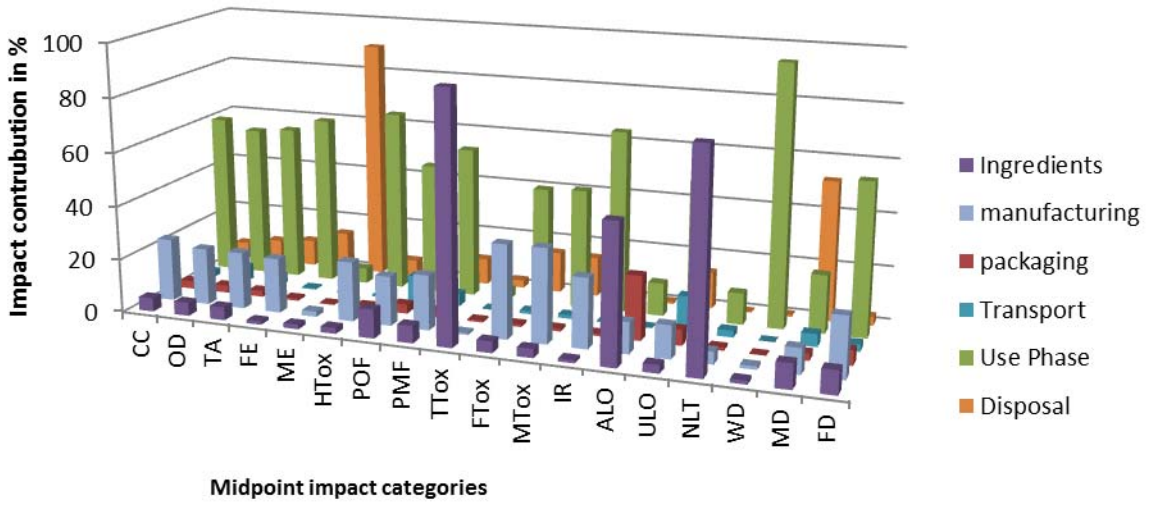

Figure 23: Impact contribution of different life cycle stages of a hand dishwashing detergent

The key environmental performance indicators (KPIs), i.e. those variables that mainly drive the results for hand dishwasher detergents in Europe, based on the results of this study, are:

Amount of product used,

Formulation; specifically the choice and amount of surfactants,

Energy consumed to heat the water (if warm water is used),

Energy source used to heat the water (if warm water is used).

Finally the sensitivity analysis gives the ranges of environmental impacts due to the identified hotspots. This analysis highlight the importance of selecting environmentally-friendlier ingredients (e.g. biodegradable surfactants, less harmful substances in terms of ecotoxicity, aquatic toxicity and biodegradability), advising consumers on the environmental benefits of using cold water, the correct dosage and the correct management of the packaging materials at the end of the life of the product.

As introduced, further research and their implications on the revision of the EU Ecolabel criteria are included in the accompanying "technical report" document. It will summarize the rationale behind each of the EU Ecolabel criteria changes proposed and will be presented as the first working document before the first AHWG meeting.

ANNEXES

Annex I: Hand dishwashing detergent ingredients

Surfactants
Surfactants (surface active agents) are the active cleaning ingredients found in detergent products. They function by changing the surface tension of water to assist with cleansing, wetting surfaces, foaming and emulsifying. In HDDs they help to remove food and soils. Anionic surfactants are the primary surfactants used in HDDs, as they tend to be high sudsing. These surfactants can accumulate and may be toxic and harmful in the environment. Therefore, to reduce the environmental impacts, surfactants which are readily biodegradable or environmentally innocuous should be chosen.

Preservatives/biocides
Preservatives are used to prevent the product from spoiling during storage by preventing the growth of microorganisms. Biocides are often used for preservation purposes, however, they can present significant risk to the environment and human health when used for purposes beyond preserving the product.

Enzymes
Enzymes are used in dishwasher detergents to improve washing performance. They function by targeting specific food deposits, which they break down into smaller parts so that they can then be removed by other ingredients in the detergent. As enzymes do not lose functionality after use, they can replace large quantities of other chemicals with the same function. Amylase and protease are commonly used in dishwasher detergent formulations.

Dyestuffs
Dyestuffs are added to the detergent formulations in order to give the detergents colour and for marketing purposes. They do not necessarily serve a purpose in the wash process.

Solubility enhancers
Solubility enhancers aid with formulation of the product and ensure that the desired physical characteristics are present. They ensure that the final product is uniform in nature and that all active ingredients are soluble in the product.

Fragrances
Fragrances are used to neutralise the inherent odour of detergent chemicals and give the laundry a pleasant smell. There are many different fragrance substances used by the detergent industry of which several are of environmental concern. For example, nitro-musks and polycyclic musk compounds are suspected of being carcinogenic and they show a tendency to accumulate in a mother's milk. As a consequence all nitro-musks are banned from EU Ecolabel laundry detergent products.

Opacifiers
Opacifiers are additives that render the product, of which it is part of, impervious to light rays. They are commonly added to liquid detergents for aesthetic appeal. Opacifiers are usually water insoluble metal compounds, such as titanium dioxide. They may be used alone to reduce translucence or with a dye to give the product a desired colour.

Annex II: Stakeholder survey

JOINT RESEARCH CENTRE

Institute for Prospective Technological Studies (IPTS)

QUESTIONNAIRE TO ANALYSE THE EXISTING SCOPE, MARKET SEGMENTATION AND ENVIRONMENTAL PERFORMANCE FOR HAND DISHWASHING DETERGENTS

Stakeholders Consultation Document

JRC EUROPEAN COMMISSION

OAKDENE HOLLINS RESEARCH & CONSULTING

ipts Institute for Prospective Technological Studies

1. INTRODUCTION

Objectives

The EU Ecolabel is a key policy instrument in promoting environmentally friendly products and services. The EU Ecolabel criteria for **hand dishwashing detergents (HDDs)** were adopted on 23 March 2005 (2005/342/EC) and revised and replaced on 24 June 2011 (2011/382/EU). Their aim was to promote cleaning detergents that represent the best 10-20 % of the products available on the EC market in terms of environmental performance considering the whole life cycle (from production, through use, and until disposal). These criteria are forseen to expire in December 2016.

The framework that sets out the EU Ecolabel criteria for HDDs defines the aims of the criteria as promoting products that have a reduced impact on aquatic ecosystems, contain a limited amount of hazardous substances, and whose performance has been tested.

There are currently criteria for each of the following aspects of HDDs:

1. Toxicity to aquatic organisms
2. Biodegradability of surfactants
3. Excluded or limited substances and mixtures
4. Fragrances
5. Corrosive properties
6. Packaging requirements
7. Fitness for use
8. User instructions
9. Information appearing on the EU Ecolabel

This questionnaire is the first stage in the process of revising the criteria for the award of the EU Ecolabel for HDDs. Its aim is to find out whether the current scope definition is still appropriate regarding the current market conditions and state of the art of the technology, and which criteria need to be amended, prolonged or withdrawn. One of the goals of the revision is to obtain simplified criteria addressing the most important environmental impacts of HDDs from a life cycle perspective.

The views of relevant stakeholders are of utmost importance.

Confidentiality and contact details

All responses received through this questionnaire will be treated as confidential. Where data is published, it will be in an aggregated format only. Comments will not be attributed to an individual person or organisation unless this is specifically requested.

We rely heavily on stakeholder consultation, so your time and expertise are greatly appreciated and valued.

For further information regarding this questionnaire, please contact us by writing to **Josie Arendorf** at the following e-mail address: **josie.arendorf@oakdenehollins.co.uk**.

Once you have completed this survey, please email it to: JRC-IPTS-Hand-Dishwashing@ec.europa.eu

Thank you for taking part!

2. QUESTIONNAIRE

2.1 Your contact details

First name:	Family name:
Email:	
Company/ Organisation:	
Position held:	
Organisation type: ☐Industry ☐Government ☐Environmental Agency ☐Trade Association ☐Competent body ☐Other (please specify)	
Company/Organisation details: Website Country Telephone Number	

2.2 Scope and definition

The product group **'Hand Dishwashing Detergents'** comprises all detergents intended to be used to wash by hand dishes, crockery, cutlery, pots, pans, kitchen utensils and so on.

The product group shall cover products for both private and professional use. The products shall be mixtures of chemical substances and must not contain micro-organisms that have been deliberately added by the manufacturer.

1. Do you find the existing product group definition easy to understand?	☐Yes ☐No	If no, please explain why and/or propose modification.
2. Is the current definition appropriate and suitable for this product?	☐Yes ☐No	If no, please explain why and/or propose modification.
3. Is the current definition of hand dishwashing detergents excluding any type of product that should be included?	☐Yes ☐No	If yes, please indicate.

These questions are specifically addressed to the EUEB members and Competent Bodies:

4. Please can you provide anonymised CDV values for EU Ecolabel products. This is required for the analysis of CDV limits.
Please send this information by email to Josie.arendorf@oakdenehollins.co.uk

5. Have producers or any other interested party had difficulty in understanding the scope of the product group, or encountered difficulties because the product was not covered within the current scope and definition?

☐Yes ☐No

If yes, please specify:

6. Have you ever denied the EU Ecolabel licence for APCs because of a product not being covered by the current scope and definition?

☐Yes ☐No

If yes, please specify:

These questions are specifically addressed to the stakeholders/licence holders:

7. Do you have any difficulty in understanding the scope of the product group?

☐Yes ☐No
If yes, please specify:

8. Have you ever been denied the EU Ecolabel licence for HDDs because of a product not being covered by the current scope and definition?

☐Yes ☐No
If yes, please specify:

2.3 Questionnaire on currently valid criteria

Criterion 1: Toxicity to aquatic organisms: Critical Dilution Volume (CDV)

The current criteria specify that the critical dilution volume of the product must not exceed the following limits (CDVchronic):	
Product type	**$CDV_{chronic}$**
Hand dishwashing detergents (diluted in water at manufacturers recommended dose for normally soiled items to create a litre of dishwashing water)	3800 L/1 L of solution

9. Is the CDV limit strict enough?	☐Yes ☐No	If no, please explain why and/or propose modification.
10. Is CDV the most appropriate method for assessing aquatic toxicity? If not, which assessment method should be considered.	☐Yes ☐No	If no, please explain why and/or propose modification.

Criterion 2: Biodegradability of surfactants

The current criteria specify that the content of surfactants in the product that are aerobically non-biodegradable (not readily biodegradable aNBO) and/or anaerobically non-biodegradable (anNBO) shall not exceed the following limits.

The current criteria specify that each surfactant in the product shall be readily biodegradable (aerobically) For anaerobic biodegradability of surfactants the following requirements apply:	
Feature	**Criterion**
Surfactants classified as H400/R50	None permitted
Total weight of anaerobically non-biodegradable surfactants that are not classified as H400/R50	< 0.20 g/1 L of dishwashing water

11. Are requirements for anaerobic biodegradability necessary for this product group? Which other parameters could be considered?	☐Yes ☐No	If no, please explain why and/or propose modification.

12. Are the current limits effective in distinguishing between the state-of-the-art and the best environmentally performing products in the HDD product group?	☐Yes ☐No	If no, please explain why and/or propose modification.
13. Are the current limits set for anaerobic biodegradability of surfactants strict enough?	☐Yes ☐No	If no, please explain why and/or propose modification.

Criterion 3: Excluded or limited substances and mixtures

Under the existing criteria, the following ingredients must not be included in the product:
Substance
APEO (alkyl phenol ethoxylates) and derivatives thereof
EDTA (ethylenediamine tetraacetic acid) and its salts
5-bromo-5-nitro-1,3-dioxane
2-bromo-2-nitropropane-1,3-diol
Diazolinidylurea
Formaldehyde
Sodium hydroxyl methyl glycinate
Nitromusks and polycyclic musks

There are restrictions on the use of quaternary ammonium salts:
Substance
Quaternary ammonium salts that are not readily biodegradable shall not be used, either as part of the formulation or as part of any mixture included in the formulation.
There are restrictions on the use of biocides
Substance
i) The product may only include biocides in order to preserve the product, and in the appropriate dosage for this purpose alone. This does not refer to surfactants, which may also have biocidal properties. ii) It is prohibited to claim or suggest on the packaging or by any other communication that the product has an antimicrobial action. iii) Biocides, either as part of the formulation or as part of any mixture included in the formulation, that are used to preserve the product and that are classified H410/R50-53 or H411/R51-53 in accordance with Directive 67/548/EEC, Directive 1999/45/EC of the European Parliament and of the Council (1) or Regulation (EC) No 1272/2008, are permitted but only if their bioaccumulation potentials are characterised by log Pow (log octanol/water partition coefficient) < 3,0 or an experimentally determined bioconcentration factor (BCF) ≤ 100.

In addition, the most critical substances regarding human health and environment must also not be included in the product. This is a standard requirement for ecolabelled washing and cleaning products. However, there are certain substances which are specifically exempted from this requirement:

Substance	Hazard statement	Risk phrase
Surfactants (in concentrations <25 % in the product)	H400 and H412	R50 and R52-53
Fragrances	H412	R52-53
Enzymes	H334 and H317	R42 and R43
NTA as in impurity in MGDA and GLDA	H351	R40

The criteria also impose restrictions on the use of substances listed in accordance with Article 59(1) of Regulation EC No 1907/2006.

14. Are there any additional ingredients which should be specifically excluded or limited from EU Ecolabelled HDDs?	☐Yes ☐No	If yes, please specify and provide rationale or supporting information.
15. Are any additional derogations required?	☐Yes ☐No	If yes, please explain why and/or propose modification and provide rationale or supporting information.

16. Are there any substances or mixtures which no longer need to be excluded?	☐Yes ☐No	If yes, please explain why and/or propose modification and provide rationale or supporting information.
17. Are further requirements needed for the use of biocides in the product?	☐Yes ☐No	If yes, please explain why and/or propose modification and provide rationale or supporting information.

Criterion 4: Fragrances

Under the current criteria the following requirements on fragrances apply:

a) Nitro- and polycyclic musk-based fragrances are prohibited as in Criterion 3.

b) Any substance added to the product as a fragrance must have been manufactured and/or handled in accordance with the code of practice of the International Fragrance Association. The code can be found on IFRA's website: http://www. ifraorg.org

c) Other fragrances may be limited to < 100 ppm (g/g) by the requirements of Regulation (EC) No 648/200 (Annex VII) or where they are classified H317/R43 may cause allergic skin reaction and/or H334/R32 may cause allergy or asthma symptoms or breathing difficulties if inhaled.

d) Fragrances are not permitted in HDDs for professional use.

18. Are there any additional fragrance ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?	☐Yes ☐No	If yes, please specify and provide rationale or supporting information.
19. Are there any further requirements needed for fragrances?	☐Yes ☐No	If yes, please specify and provide rationale or supporting information.

Criterion 5: Corrosive properties

The current criteria state that the product shall not be classified as a 'Corrosive' (C) mixture with R34 or R35 in accordance with Directive 1999/45/EC, or as a 'Skin Category 1' mixture in accordance with Regulation (EC) No 1272/2008.

20. Are the requirements on corrosive properties sufficient?	☐Yes ☐No	If no, please explain why and/or propose modification.

Criterion 6: Packaging requirements

The existing criteria specify the following requirements on packaging:

a) Plastics that are used for the main container must be marked in accordance with EC Directive 94/62/EC or DIN 6120 part 1 and 2 in connection with DIN 7728 part 1.

b) If the primary packaging is made of recycled material, any indication of this on the packaging shall be in conformity with the ISO 14021 standard

c) Only phthalates that at the time of application have been risk assessed and have not been classified according to criterion 3c may be used in the plastic packaging

d) The weight utility ratio (for primary packaging) must not exceed the following values:

Product type	**WUR**
HDDs that are diluted in water prior to use	1.2 g/ L use solution (dishwashing water)

21. Do you think that is it necessary to have a criterion on packaging requirements for this product group?	☐Yes ☐No	If no, please explain why and/or propose modification.
22. Are the WUR limits acceptable for HDDs currently on the market?	☐Yes ☐No	If no, please explain why and/or propose modification.
23. Should additional criteria be set to further promote the use of recycled materials in packaging?	☐Yes ☐No	If yes, please explain why and/or propose modification.
24. Should there be restrictions on combinations of materials used for packaging? For instance to encourage design for recycling (like the new proposed criterion for rinse-off cosmetics).	☐Yes ☐No	If yes, please explain why and/or propose modification.

Criterion 7: Washing performance (fitness for use)

The existing criteria state that the product shall be fit for use, meeting the needs of the consumer. The criteria state that the product shall comply with the performance requirements as specified in the latest version of the EU Ecolabel HDD performance test which can be found here: http://ec.europa.eu/environment/ecolabel/documents/performance_test.pdf

25. **Please provide us with your comments on the washing performance test and, if appropriate proposals for modification**

Criterion 8: User instructions

Under the existing criteria, the product shall bear the following information on the packaging: a) 'Do not use running water but immerse the dishes, and use the recommended dosage' (or equivalent text) b) Information on the recommended dosage shall appear on the packaging in a reasonably sufficient size and against a visible background. The information shall be provided in millilitres (and tea spoons) of product for 5 litres of dishwashing water suitable for 'dirty' and 'less dirty' dishes. c) An indication of the approximate number of washes that the consumer can perform with one bottle is recommended but voluntary.

26. Are additional requirements and instructions for dosage needed?	☐Yes ☐No	If yes, please explain why you think so.

Criterion 9: Information appearing on the EU Ecolabel

An optional label with text box shall contain the following text: • Reduced impact on aquatic life • Reduced use of hazardous substances • Reduced packaging waste • Clear user instructions

27. Is there any other information which should be included on the EU Ecolabel claims text?	☐Yes ☐No	If yes, please specify.

2.3 Further issues or hot spots for HDDs

The current criteria are set for 9 different aspects of HDDs, with the aim of promoting products which have a reduced impact on aquatic ecosystems, contain a limited amount of hazardous substances, and whose performance has been tested.

28. **Should further criterion be developed, either because all the issues are not already covered or because of recent developments which affect the environmental performance of HDDs?**

29. **Do you consider it feasible to link the CDV and performance criteria? If yes, please explain your approach.**

30. **Do you know of any examples of the use of nanomaterials in HDDs? Should their use be banned from this product group and why?**

2.4 Market data

The market analysis forms an integral part of the criteria revision process, as it identifies important drivers, trends and innovations in the market for HDDs.

If you have any information on market statistics for the HDD product group, please mention it here so that we can get in touch with you and collect the details needed for the project. Thank you in advance for your cooperation.

2.5 Commission statement

Please find below the Commission statement accompanying the criteria revision to see the issues which should particularly be taken into account.

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate C –Industry
ENV.C1 – Environment & Industry
Head of Unit

Brussels, 11 February 2011
ENV/C1

Summary of the meeting of the Regulatory Committee established under Article 16 of Regulation (EC) N° 66/2010 of 25 November 2009 of the European Parliament and of the Council on the EU Ecolabel

COMMISSION STATEMENT

On the occasion of the next revision of the criteria for the award of the EU Ecolabel to hand dishwashing detergents:

- Adaptation of the criteria on nanomaterials in regards to developments in risk assessment methodologies and test methods as well as the legal definition;
- Re-assess the anaerobic biodegradation criterion;
- Investigate potential environmental benefits of using raw materials from renewable sources;
- Re-assess the methodology for CDV calculation as well as the limits;
- Investigate the use of environmentally hazardous biocides in Ecolabelled products;
- Investigate the use of life-cycle impact assessment methods, for example, the Usetox.

p.o. RBMY

Pavel Misiga

European Commission, B-1049 Brussels - Belgium - Office: BU-9 4/138
Telephone: direct line (+32-2)2960752, switchboard 299.11.11. Fax: 295.56.84.

Annex III: Life cycle impact assessment

For each substance, a schematic cause and effect pathway needs to be developed that describes the environmental mechanism of the substance emitted. Along this environmental mechanism an impact category indicator result can be chosen either at the midpoint or endpoint level. Endpoint results have a higher level of uncertainty compared to midpoint results but are easier to understand by decision makers.

- **Midpoint** impact category, or problem-oriented approach, translates impacts into environmental themes such as climate change, acidification, human toxicity, etc.
- **Endpoint** impact category, also known as the damage-oriented approach, translates environmental impacts into issues of concern such as human health, natural environment, and natural resources.

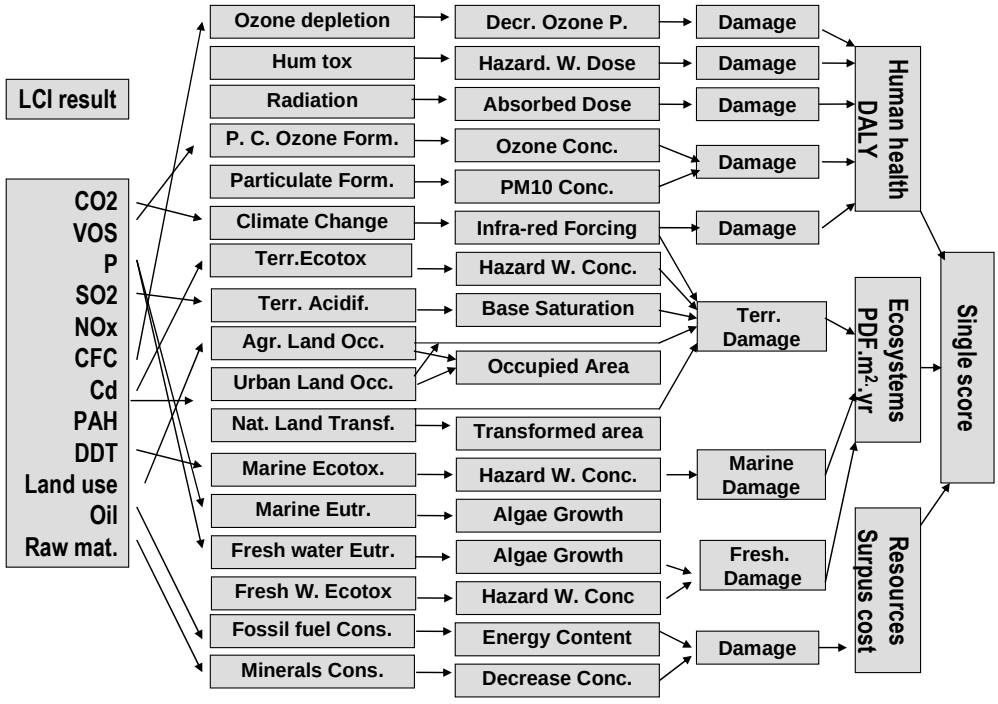

Figure 23: Relationship between LCI parameters (left), midpoint (middle) and endpoint indicator (right) in ReCiPe 2009

Annex IV: Contribution analysis of different life cycle stages

Table 42: Life cycle impact contribution of an HDD

Impact category	Unit	Ingredients	Manufacturing	Packaging	Transport	Use phase	Disposal
CC	kg CO_2 eq	2,91E-03	1,34E-02	1,65E-03	1,45E-03	3,45E-02	3,52E-03
OD	kg CFC-11 eq	1,48E-10	6,33E-10	8,19E-11	1,77E-10	1,70E-09	2,54E-10
TA	kg SO_2 eq	1,24E-05	5,32E-05	5,72E-06	9,30E-06	1,46E-04	2,48E-05
FE	kg P eq	7,14E-07	1,14E-05	5,04E-07	2,64E-07	3,50E-05	7,94E-06
ME	kg N eq	2,96E-06	3,43E-06	5,74E-07	5,65E-07	9,75E-06	1,55E-04
Htox	kg 1,4-DB eq	7,49E-04	7,50E-03	4,33E-04	2,47E-04	2,28E-02	2,09E-03
POF	kg NMVOC	1,63E-05	2,81E-05	5,26E-06	1,48E-05	7,44E-05	1,40E-05
PMF	kg PM10 eq	5,40E-06	1,72E-05	2,10E-06	4,00E-06	4,72E-05	8,22E-06
Ttox	kg 1,4-DB eq	4,07E-05	3,23E-07	3,08E-07	1,09E-07	1,55E-06	1,24E-06
Ftox	kg 1,4-DB eq	2,14E-05	1,74E-04	4,64E-06	5,73E-06	2,18E-04	7,63E-05
Mtox	kg 1,4-DB eq	1,64E-05	1,71E-04	5,56E-06	6,43E-06	2,17E-04	7,21E-05
IR	kg U235 eq	4,46E-04	1,02E-02	3,67E-04	2,43E-04	2,66E-02	1,55E-03
ALO	m^2a	2,62E-03	5,92E-04	1,21E-03	9,09E-06	6,26E-04	3,63E-05
ULO	m^2a	1,32E-05	5,15E-05	2,50E-05	5,62E-05	2,18E-04	5,75E-05
NLT	m^2	2,89E-05	1,67E-06	3,96E-07	9,04E-07	4,24E-06	7,36E-08
WD	m^3	1,25E-04	1,10E-04	1,04E-05	6,52E-06	8,75E-03	6,14E-05
MD	kg Fe eq	1,60E-04	1,64E-04	4,57E-05	8,20E-05	3,75E-04	9,02E-04
FD	kg oil eq	1,43E-03	3,67E-03	9,12E-04	4,59E-04	9,31E-03	5,43E-04

Table 43: Life cycle impact contribution of a HDD (in percentages)

Impact category	Unit	Ingredients	Manufacturing	Packaging	Transport	Use phase	Disposal
CC	%	5	23	3	3	60	6
OD	%	5	21	3	6	57	8
TA	%	5	21	2	4	58	10
FE	%	1	20	1	0	63	14
ME	%	2	2	0	0	6	90
Htox	%	2	22	1	1	67	6
POF	%	11	18	3	10	49	9
PMF	%	6	20	2	5	56	10
Ttox	%	92	1	1	0	4	3
Ftox	%	4	35	1	1	44	15
Mtox	%	3	35	1	1	44	15
IR	%	1	26	1	1	67	4
ALO	%	51	12	24	0	12	1
ULO	%	3	12	6	13	52	14
NLT	%	80	5	1	2	12	0
WD	%	1	1	0	0	97	1
MD	%	9	9	3	5	22	52
FD	%	9	22	6	3	57	3

Annex V: Sensitivity analysis

Product formulation sensitivity

Table 44 shows the results of the 'Full sink'versus 'Direct application'.

Table 44: Impact contribution of the 'full sink' versus 'direct application' scenario

Impact category	Unit	Full sink	Direct application
Climate change	kg CO_2 eq	5,76E-02	1,05E-01
Ozone depletion	kg CFC-11 eq	3,01E-09	5,49E-09
Terrestrial acidification	kg SO_2 eq	2,52E-04	4,64E-04
Freshwater eutrophication	kg P eq	5,59E-05	1,05E-04
Marine eutrophication	kg N eq	1,72E-04	3,40E-04
Human toxicity	kg 1,4-DB eq	3,38E-02	6,31E-02
Photochemical oxidant formation	kg NMVOC	1,53E-04	2,74E-04
Particulate matter formation	kg PM10 eq	8,42E-05	1,54E-04
Terrestrial ecotoxicity	kg 1,4-DB eq	4,41E-05	6,76E-05
Freshwater ecotoxicity	kg 1,4-DB eq	5,00E-04	8,96E-04
Marine ecotoxicity	kg 1,4-DB eq	4,89E-04	8,77E-04
Ionising radiation	kg U235 eq	3,95E-02	7,33E-02
Agricultural land occupation	m^2a	4,66E-03	7,33E-03
Urban land occupation	m^2a	4,15E-04	7,60E-04
Natural land transformation	m^2	3,61E-05	5,63E-05
Water depletion	m^3	9,07E-03	1,80E-02
Metal depletion	kg Fe eq	1,73E-03	3,23E-03
Fossil depletion	kg oil eq	1,64E-02	2,95E-02

Sensitivity to warm water use

Table 45 shows the results for the sensitivity to the amount warm water used.

Table 45: sensitivity to the amount of heated water

Impact category	Unit	7,5 L	3 L	15 L
Climate change	kg CO2 eq	5,76E-02	3,52E-02	9,50E-02
Ozone depletion	kg CFC-11 eq	3,01E-09	1,84E-09	4,96E-09
Terrestrial acidification	kg SO2 eq	2,52E-04	1,50E-04	4,23E-04
Freshwater eutrophication	kg P eq	5,59E-05	3,02E-05	9,89E-05
Marine eutrophication	kg N eq	1,72E-04	7,41E-05	3,36E-04
Human toxicity	kg 1,4-DB eq	3,38E-02	1,90E-02	5,85E-02
Photochemical oxidant formation	kg NMVOC	1,53E-04	1,00E-04	2,41E-04
Particulate matter formation	kg PM10 eq	8,42E-05	5,10E-05	1,40E-04
Terrestrial ecotoxicity	kg 1,4-DB eq	4,41E-05	4,24E-05	4,69E-05
Freshwater ecotoxicity	kg 1,4-DB eq	5,00E-04	3,24E-04	7,92E-04
Marine ecotoxicity	kg 1,4-DB eq	4,89E-04	3,16E-04	7,77E-04
Ionising radiation	kg U235 eq	3,95E-02	2,26E-02	6,76E-02
Agricultural land occupation	m2a	4,66E-03	4,27E-03	5,33E-03
Urban land occupation	m2a	4,15E-04	2,51E-04	6,89E-04
Natural land transformation	m2	3,61E-05	3,35E-05	4,04E-05

Water depletion	m3	9,07E-03	3,78E-03	1,79E-02
Metal depletion	kg Fe eq	1,73E-03	9,61E-04	3,00E-03
Fossil depletion	kg oil eq	1,64E-02	1,05E-02	2,63E-02

Surfactant origin

Table 46 shows the results for sensitivity to surfactant origin.

Table 46: Impact contribution of surfactant origin

Impact category	Unit	1/6 mix plant/petro	Only petro-chem-ical derived	Only plant derived
Climate change	kg CO_2 eq	5,76E-02	5,75E-02	5,77E-02
Ozone depletion	kg CFC-11 eq	3,01E-09	3,01E-09	3,02E-09
Terrestrial acidification	kg SO_2 eq	2,52E-04	2,50E-04	2,53E-04
Freshwater eutrophication	kg P eq	5,59E-05	5,59E-05	5,60E-05
Marine eutrophication	kg N eq	1,72E-04	1,70E-04	1,74E-04
Human toxicity	kg 1,4-DB eq	3,38E-02	3,37E-02	3,39E-02
Photochemical oxidant formation	kg NMVOC	1,53E-04	1,52E-04	1,54E-04
Particulate matter formation	kg PM10 eq	8,42E-05	8,22E-05	8,52E-05
Terrestrial ecotoxicity	kg 1,4-DB eq	4,41E-05	3,48E-06	6,44E-05
Freshwater ecotoxicity	kg 1,4-DB eq	5,00E-04	4,89E-04	5,05E-04
Marine ecotoxicity	kg 1,4-DB eq	4,89E-04	4,84E-04	4,91E-04
Ionising radiation	kg U235 eq	3,95E-02	3,94E-02	3,95E-02
Agricultural land occupation	m^2a	4,66E-03	2,09E-03	5,95E-03
Urban land occupation	m^2a	4,15E-04	4,12E-04	4,17E-04
Natural land transformation	m^2	3,61E-05	7,57E-06	5,04E-05
Water depletion	m^3	9,07E-03	8,96E-03	9,12E-03
Metal depletion	kg Fe eq	1,73E-03	1,69E-03	1,75E-03
Fossil depletion	kg oil eq	1,64E-02	1,69E-02	1,62E-02

Product dosage sensitivity

Table 47 shows the results of the product dosage sensitivity analysis.

Table 47: Impact contribution of the product dosage sensitivity

Impact category	Unit	half dose (4ml)	Baseline (8ml)	double dose (16ml)
Climate change	kg CO_2 eq	4,75E-02	5,76E-02	7,79E-02
Ozone depletion	kg CFC-11 eq	2,48E-09	3,01E-09	4,08E-09
Terrestrial acidification	kg SO_2 eq	2,12E-04	2,52E-04	3,33E-04
Freshwater eutrophication	kg P eq	4,95E-05	5,59E-05	6,89E-05
Marine eutrophication	kg N eq	1,68E-04	1,72E-04	1,81E-04
Human toxicity	kg 1,4-DB eq	2,93E-02	3,38E-02	4,29E-02
Photochemical oxidant formation	kg NMVOC	1,21E-04	1,53E-04	2,19E-04
Particulate matter formation	kg PM10 eq	6,98E-05	8,42E-05	1,13E-04
Terrestrial ecotoxicity	kg 1,4-DB eq	2,34E-05	4,41E-05	8,54E-05

Freshwater ecotoxicity	kg 1,4-DB eq	3,96E-04	5,00E-04	7,07E-04
Marine ecotoxicity	kg 1,4-DB eq	3,88E-04	4,89E-04	6,89E-04
Ionising radiation	kg U235 eq	3,38E-02	3,95E-02	5,07E-02
Agricultural land occupation	m^2a	2,66E-03	4,66E-03	8,67E-03
Urban land occupation	m^2a	3,44E-04	4,15E-04	5,57E-04
Natural land transformation	m^2	2,02E-05	3,61E-05	6,79E-05
Water depletion	m3	8,94E-03	9,07E-03	9,32E-03
Metal depletion	kg Fe eq	1,50E-03	1,73E-03	2,18E-03
Fossil depletion	kg oil eq	1,31E-02	1,64E-02	2,30E-02

Energy source sensitivity

Table 48 shows the results for the energy source sensitivity analysis

Table 48: Impact contribution of energy source sensitivity

Impact category	Unit	UCTE	FR	CH	NL
Climate change	kg CO_2 eq	5,76E-02	3,12E-02	2,71E-02	6,56E-02
Ozone depletion	kg CFC-11 eq	3,01E-09	1,72E-09	2,34E-09	2,94E-09
Terrestrial acidification	kg SO_2 eq	2,52E-04	1,48E-04	1,23E-04	1,74E-04
Freshwater eutrophication	kg P eq	5,59E-05	2,71E-05	2,49E-05	3,45E-05
Marine eutrophication	kg N eq	1,72E-04	1,65E-04	1,64E-04	1,68E-04
Human toxicity	kg 1,4-DB eq	3,38E-02	2,00E-02	1,77E-02	2,30E-02
Photochemical oxidant formation	kg NMVOC	1,53E-04	1,04E-04	9,05E-05	1,47E-04
Particulate matter formation	kg PM10 eq	8,42E-05	5,35E-05	4,53E-05	6,32E-05
Terrestrial ecotoxicity	kg 1,4-DB eq	4,41E-05	4,37E-05	4,35E-05	4,36E-05
Freshwater ecotoxicity	kg 1,4-DB eq	5,00E-04	4,58E-04	4,14E-04	5,51E-04
Marine ecotoxicity	kg 1,4-DB eq	4,89E-04	4,41E-04	3,96E-04	5,39E-04
Ionising radiation	kg U235 eq	3,95E-02	8,14E-02	4,66E-02	1,73E-02
Agricultural land occupation	m^2a	4,66E-03	4,36E-03	4,29E-03	4,81E-03
Urban land occupation	m^2a	4,15E-04	3,51E-04	3,26E-04	4,42E-04
Natural land transformation	m^2	3,61E-05	3,35E-05	3,31E-05	4,11E-05
Water depletion	m^3	9,07E-03	9,15E-03	9,03E-03	8,94E-03
Metal depletion	kg Fe eq	1,73E-03	2,99E-03	2,89E-03	2,81E-03
Fossil depletion	kg oil eq	1,64E-02	9,11E-03	8,12E-03	2,04E-02

Method sensitivity

Table 49 shows the results for the method sensitivity analysis: the comparison to ILCD.

Table 49: Life cycle impact contribution of an APC, according to ILCD midpoint

Impact category	Unit	Ingred-ients	Manu-facturing	Pack-aging	Trans-port	Use Phase	Disposal
Climate change	kg CO_2 eq	2,91E-03	1,28E-02	2,41E-03	1,45E-03	3,45E-02	3,52E-03
Ozone depletion	kg CFC-11 eq	1,48E-10	6,05E-10	1,31E-10	1,77E-10	1,70E-09	2,53E-10
Human toxicity,	kg SO_2 eq	1,25E-10	9,22E-10	1,54E-10	1,10E-10	3,32E-09	1,24E-09

cancer effects							
Human toxicity, non-cancer effects	kg P eq	3,27E-10	3,36E-09	2,02E-10	2,21E-10	3,11E-09	1,54E-08
Particulate matter	kg N eq	2,54E-06	6,10E-06	1,33E-06	6,10E-07	1,49E-05	2,08E-06
Ionizing radiation HH	kg 1,4-DB eq	4,46E-04	9,84E-03	7,40E-04	2,43E-04	2,66E-02	1,55E-03
Ionizing radiation E (interim)	kg NMVOC	1,38E-09	3,03E-08	2,29E-09	7,47E-10	8,26E-08	4,68E-09
Photochemical ozone formation	kg PM10 eq	1,56E-05	2,65E-05	6,86E-06	1,47E-05	7,35E-05	1,35E-05
Acidification	kg 1,4-DB eq	1,61E-05	6,67E-05	1,11E-05	1,23E-05	1,92E-04	3,20E-05
Terrestrial eutrophication	kg 1,4-DB eq	3,97E-05	9,35E-05	2,03E-05	5,48E-05	2,55E-04	9,09E-05
Freshwater eutrophication	kg 1,4-DB eq	7,42E-07	1,09E-05	1,09E-06	2,64E-07	3,50E-05	7,94E-06
Marine eutrophication	kg U235 eq	4,37E-06	1,06E-05	2,23E-06	5,03E-06	2,97E-05	1,53E-04
Freshwater ecotoxicity	m^2a	1,21E-02	8,42E-02	4,30E-03	4,65E-03	6,93E-02	7,29E-02
Land use	m^2a	1,34E-03	6,11E-03	4,22E-03	3,91E-03	2,71E-02	2,95E-03
Water resource depletion	m^2	2,96E-05	7,91E-05	1,44E-05	2,45E-06	1,59E-03	1,41E-05
Mineral, fossil & ren resource depletion	m^3	4,55E-08	5,32E-08	5,96E-09	1,80E-08	1,30E-07	1,34E-07

Annex VI: Place settings

According to Stamminger et al. 50 % of the respondents wash their dishes before or after each meal. Assuming that an 'average' family consist of 2 adults and 2 children an average washing would consist of a four persons place settings. According Stamminger et al. one place setting consists of a dinner plate, soup plate, dessert plate, a glass , tea cup and saucer, a knife, fork, soup spoon, dessert spoon, teaspoon and additional serving pieces.

This means that the washing up with four place settings is assumed to consist of:

- 4 Dinner plates
- 4 Dessert plates
- 4 Glasses
- 4 Tea cups and saucers
- 4 Knives, forks, soup spoons, dessert spoons and teaspoons
- 1-2 Serving plates and serving spoons
- 4 Bowls

Annex VII: Detailed feedback from the stakeholders to the first questionnaire

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
Scope and definition	Do you find the existing product group definition easy to understand?			No comments
	Is the current definition appropriate and suitable for this product?			No comments
	Is the current definition of hand dishwashing detergents excluding any type of product that should be included?			No comments
1. Toxicity to aquatic organisms: CDV	Is the CDV limit strict enough?	Y	Industry	However, with a super concentrate we passed the requirement well.
		N	Competent body	2500 L/l is possible
		N	Industry	2500 L/1L of solution will be more restrictive
		N	Competent body	I think we can reduce the limits because most of the products have CDV values much lower and the ecolabel certification must remain restrictive.
		N	Competent body	This can be much lower, I send already data about the CDVtox of the current EU Ecolabel products. A lot of those products has a CDVtox that is much lower than 3800. 2200L/1L of solution should be feasable. The revision of the new didlist should be taken into account, I did some comparative calculations and for most of the products the use of the new didlist results in a lower CDVtox.
		N	Industry	Our CDV tox values for HDD are lower than 1500L. It is possible to reduce the limit.
	Is CDV the most appropriate method for assessing aquatic toxicity? If not, which assessment method should be considered?	N	Industry	The CDV is very much a hazard based tool, whereas environmental risk of each ingredient would be the most appropriate parameter, such as done by REACH.
		Y	Competent body	Regarding CDV and USEtox please refer to opinion described in email
		N	Industry association	CDV criteria are taking a pure hazard approach, whereas looking at environmental risk of each ingredient would be the most logical approach (which is also the approach of REACH).
		Y	Competent body	I believe we don't have enough information available about others methods

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
		N/A	Industry	It has can be other methods there better but not knowing them it is difficult to answer.
		Y	Industry	Use tox database isn't as complete as vcdtox database. For example: Malic acid.
2. Biodegradability of organics	Are requirements for anaerobic biodegradability necessary for this product group? Which other parameters could be considered?	N	Industry	Anaerobic biodegradability is not a relevant environmental parameter
		N	Industry	Anaerobic biodegradability is not a relevant environmental parameter, as concluded by the Commission (SCHER) in 2009.
		N	Industry	Research on availability of raw materials with anaerobic biodegradability should be done.
		N	Industry association	Anaerobic biodegradability is not a relevant environmental parameter (as concluded by SCHER in 2008)
		N	Competent body	The commission decision of 28 May 2014 amending Decisions 2011/382/EU allows the using of surfactants classified H411 (2.5% authorized). This amendment has to be cancelled because alternatives are possible.
		Y	Competent body	Surfactants should be anaerobic biodegradable. As the EU Ecolabel is a volontary label and a label of excellence surfactants should be anaerobicaly biodegradable too, even if most of them are aerobically biodegraded in wastewater treatment there are still situations where they can end up in anaerobical circumstances. Second reason in the new criteria for rinse-off cosmetics this is also required, the EU Ecolabel should be consequent and it is possible to have weel performing HDD's with only surfactants that are aerobic and anaerobic biodegradable.
		N	Industry	Other parameter to forbit: the using of surfactants classified H411 (2.5% authorized from now) because alternatives no classified H411 are possible
	Are the current limits effective in distinguishing between the state-of-the-art and the best environmentally performing products in the HDD product group?	N	Industry	Anaerobic biodegradability is not relevant (see question 11) for the environmental performance of surfactants, if they are already readily biodegradable (aerobically)
		N	Industry association	Anaerobic biodegradability does not define the environmental performance of surfactants, if they are already readily biodegradable (aerobically)

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
		N	Competent body	There are products that contain surfactants that are anaerobically biodegradable
		N	Competent body	We can reduce the threshold of anaerobically non-biodegradable surfactants that are not classified as H400/R50.
		N	Industry	0.20g/1L of anNBO surfactants is too much. In general for this product category, you use less than 20% of surfactants in formulas for a dosage of 5mL/5L of water = 0.20g of anNBO / 1L of diswashing water. So the current criteria allows near the total quantity of required surfactants in anNBO surfactants that is not good.
	Are the current limits set for anaerobic biodegradability of surfactants strict enough?	Y	Industry	Actually they are too strict (see Q.11) (Anaerobic biodegradability is not a relevant environmental parameter)
		Y	Industry	Actually they are too strict
		N	Industry	Research on availability of raw materials with anaerobic biodegradability should be done.
		Y	Industry association	Actually they are too strict (see Q.11)
		N	Competent body	We can reduce the threshold of anaerobically non-biodegradable surfactants that are not classified as H400/R50 because most of the products (currently certified) have values << 0,2g.
		N	Competent body	All surfactants should be anaerobicly biodegradable.
		N	Industry	Forbid aNBO surfactants.
3. Excluded or limited substances and mixtures	Are there any additional ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?	Y	Competent body	Endocrine disruptors, vPvB, PBT and SVHC
		Y	Industry	Liberator of formaldehyde should not be used
		Y	Competent body	We can forbid enzymes because most products would not include them. We can also cancel the exemption for NTA because we don't see this substance in the chemicals formulations. In addition, quaternary ammonium salts are rarely used so we can forbid them.
		Y	Industry	Exclude Surfactants classisfied H411 (from now 2.5% authorized) . Exclude enzymes (not necessary for these products).
		Y	Industry	Chloromethylisothiazolinone
	Are any additional derogations required?	Y	Industry	H400 for enzymes & H411 for surfactants
		N	Industry	Note that derogation for surfactants classified as H411 <2.5 %, is

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
				not in this document yet
		Y	Industry association	Some proteases can be classified as H400. A derogation could be considered, similarly to the amendment made to the I&I laundry and dishwashing detergents criteria. Also, please note that this document is not taking into account yet the derogation recently published for surfactants classified as H411 in total concentrations < 2,5 % in the final product.
		N	Industry	It's quite difficult to preserve Ecolabel dishwashing products so it will be interesting to allow the R43 (or H317) and R52 (or H412) for the preservatives
	Are there any substances or mixtures which no longer need to be excluded?	Y	Industry	APEO: are not used due to their limited biodegradability
		Y	Industry	APEO: are not used due to their too low biodegradability
		Y	Industry association	APEO: are not used due to their limited biodegradability
		Y	Industry	Quaternary ammonium salts shall not be used even if there are readily biodegradable
	Are further requirements needed for the use of biocides in the product?	Y	Industry	Research on more sustainable preservatives could be useful.
		Y	Competent body	Why does the criteria accept risk phrases H410 and H411 and forbid H412, is it an error?
4. Fragrances	Are there any additional fragrance ingredients which should be specifically excluded or limited from EU Ecolabel HDDs?			
	Are there any further requirements needed for fragrances?	Y	Industry	There need to be a better solution for CDV calculation of fragrances. Now we need to use 100 % concentration for every perfume. CDV calculation for every ingredient (if available) should be better and stimulates the use of more sustainable fragrances.
		Y	Industry	Allow fragrance in professional product.
		Y	Industry	It is not logical not to authorize flavors for the professional products. It favors the other markets like ecocert.
		Y	Competent body	Criterion 4c isn't clearly written, it seems that it is already covered by criterion 3 unless here the perfum as a whole is meant and not the different substances in the perfume.
		Y	Industry	It is possible to permit fragrances in professionnal product with the same requirements than private products.

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
5. Corrosive properties	Are the requirements on corrosive properties sufficient?	Y	Industry	However industry initiatives such as Detnet should also be allowed.
6. Packaging requirements	Do you think that is it necessary to have a criterion on packaging requirements for this product group?	Y	Industry Association	Yes, the packaging of these products is ultimately part of the package purchases by the final consumer.
		N	Industry	In the lowest possible will of the WUR, we lose on the quality of packagings and we risk to create dissatisfactions of the users.
	Are the WUR limits acceptable for HDDs currently on the market?	N	Industry	WUR are too strict, versus a rather limited impact of packaging as a whole on the impact of a hand dishwashing detergent. Advice on recycling of the packaging could be used alternatively.
		N	Competent body	This limit could be more stringent, See Nordic Swan for limit
		N	Industry association	WUR are too strict, whereas the impact of packaging on the environmental impact of detergents does not justify this.
		N	Competent body	We can reduce the threshold. If it's necessary, we can send you our values (for currently certified products).
		Y	Industry	For the moment, yes, but if the WUR is too low we risk to decrease the quality of packagings.
		N	Competent body	The WUR limit can be much lower.
	Should additional criteria be set to further promote the use of recycled materials in packaging?	N	Industry	Any recycling criteria should not go further that what is reality in the market w.r.t. availability of recycled materials of sufficient quality.
		Y	Industry	Recycled materials are slowly being more available to the market; it would be good to stimulate this in EU Ecolabel. Perhaps research to bio-based plastic and other new forms of packaging materials could be useful.
		Y	Industry association	A criterion promoting the use of recycled material will reduce the environmental impact of the packaging.
		N	Industry association	Recycling criteria should not go beyond market reality.
		Y	Competent body	I think it is possible, there is already a lot of packaging on the market with at least some recycled content. The requirement shouldn't be too high because the quality has to stay high and a high % of recycled content doesn't allow a white transparent bottle
	Should there be restrictions on combinations	N	Industry	But could be yes, if it can be proven that a certain kind of

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
	of materials used for packaging? For instance to encourage design for recycling (like the new proposed criterion for rinse-off cosmetics).			packaging cannot be recycled at all, and that efficient & economically viable alternatives with same functionality exist.
		N	Industry	We use quite a lot of very low weight laminated pouches, these packaging have many sustainable advantages: less transportation, less stock and less waste. However these pouches need to go to rest plastic waste for recycling.
		Y	Industry association	Non compatible materials are the major barrier to improve the recyclability of packaging (at the recycler and at the sorting plants). Additionally, easy-to-empty and easy-to-access concepts and indexes could also ease the recycling process. See www.recyclass.eu
		Y	Competent body	To ease recycling different materials should be easily separated
		N	Industry association	Unless it can be proven that a certain kind of packaging cannot be recycled at all.
		N	Industry	Some packaging are inevitably multi-materials (doypack for example) and it's technicaly impossible to have a monomaterial packaging.
7. Washing performance (fitness for use)	Please provide us with your comments on the washing performance test and, if appropriate proposals for modification	N/A	Industry	The currently proposed IKW test protocol is sufficient
		N/A	Testing institute	Ingredients for the soil preparation should be general available (at least within one country). Instead of 'local' source or "not specified" some clarifications are needed because the use of specific ingredients can one-sidedly influence the plate numbers. Concerning this matter, the reference product is unfortunately rather robust.
		N/A	Industry	We are more a supporter for consumer test because the difference we see in lab tests are not relevant for use in practice and bring unnecessary high costs for certification.
		N/A	Testing institute	At least five repetitions should be increased to at least 20 - We suggest a chemical characterization to be attached to the performance test to allow certain compositional characteristics of the product in order to strengthen the declared in composition. This allows a further quality control.
		N/A	Industry association	The currently proposed IKW test protocol is sufficient

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
		N/A	Industry	No particular comment, the test is suited.
		N/A	Competent body	The framework requires a too detailed report of different parameters e.g. how the temperature remains constant,...In the framework for APC less details are asked for, this is better. All the detergents score much better than the reference detergent, it seems that the reference detergent is rather weak.
		N/A	Industry	Ok for this criteria. Maybe it is possible to eliminate foam criteria from the test that is not a proof of efficacity.
8. User instructions	Are additional requirements and instructions for dosage needed?	Y	Industry	Mentioning dosage in Teaspoons is not relevant for professional market. Would be better to have the choice => replacing "and" by 'or'.
		Y	Industry	For professional use a dosage per litre is better, because sinks are often bigger than 5 litre in professional areas.
		Y	Industry	Advise the customer to apply for a rinse step after the hand-wash.
		Y	Industry association	Mentioning the dosage in teaspoons is not relevant for the professional products. Item b) should read as "in millilitres (and teaspoons) for consumer products and in millilitres for professional products".
		Y	Competent body	We can precise in the criteria how many milliters are contained in a tea spoon. Furthermore, it seems to be useless to have this information (in tea spoons) for professional products.
		N/A	Competent body	The naming of dirty should be the same as refered to in the reference dose. Now it is "dirty" and "normally soiled", this is confusing.
9. Information appearing on the EU Ecolabel	Is there any other information which should be included on the EU Ecolabel claims text?	Y	Competent body	Can claim the performance of the products.
		N/A	Industry	How is going to take place the labeling at the level SGH?
10. Further issues or hot spots for HDDS	Should further criterion be developed, either because all the issues are not already covered or because of recent developments which affect the environmental performance of HDDs?	N/A	Industry	One could consider sustainable sourcing of renewable, making use of existing schemes (e.g. from RSPO)
		N/A	Industry	For professional use training and/or product information sheets could also stimulate more sustainable use.
		N/A	Industry	Yes, a criterion in regard with the use of Raw materials based on renewable carbon.

Criterion	Question	Response (Y/N)	Stakeholder type	Comment
		N/A	Industry association	Potentially sustainable sourcing of renewables could be considered, there where schemes are in place.
	Do you consider it feasible to link the CDV and performance criteria? If yes, please explain your approach	N/A	Industry	No. Fragrances dominate CDV score too much, but do not contribute to technical performance. In other words, there is no clear link to technical performance and CDV.
		N/A	Industry	No; The performance is linked to a specific chemistry (example: acidic material with a good CDV is a bad degreaser...)
		N/A	Industry association	No. CDV is too much driven by fragrance, which is not linked to cleaning performance, but which is one of the drivers for consumer preference
		N/A	Industry	No. The CDV tox depends to raw materials used in the formulations. Even if you choose raw materials with low CDV tox values, you must be as efficient as the ecolabel reference.
	Do you know of any examples of the use of nanomaterials in HDDs? Should their use be banned from this product group and why?	N/A	Industry	I do not know any example. Yes, nanomaterials should be banned in relation with possible health concern.
		N/A	Competent body	Our experts are checking this, probably I come back to you with an answer on this question next week.

Annex VIII: Detergents production process and chemistry involved

Source: Manufacturing of detergents was compiled by Heather Wansbrough from two articles, one from Ralph Laing and the other from Paul Milson and with reference to:
- the enclyclopedia Britannica (15th Ed) Encyclopedia Britannica Inc 1979
- Selinger, Ben; Chemistry in the market place (3rd Ed); Harcourt brace Jovannovich, 1986

Detergents are produced industrially in four basic steps. This annex lists different steps because in the industrial processes described each of these is done over several process steps, but in principle it could be done in the three steps outlined here.

Step 1 – Saponification
A mixture of tallow (animal fat) and coconut oil is mixed with sodium hydroxide and heated. The detergent produced is the salt of a long chain carboxylic acid

Step 2 – Glycerine removal
Glycerine is more valuable than detergent, so most of it is removed. Some is left in the detergent to help make it soft and smooth. Detergent is not very soluble in salt water, whereas glycerine is, so salt is added to the wet detergent causing it to separate out into detergent (soap) and glycerine in salt water

Step 3 – Soap purification
Any remaining sodium hydroxide is neutralized with a weak acid such as citric acid and two thirds of the remaining water removed

Step 4 – Finishing
Additives such as preservatives, colour and perfume are added and mixed in with the soap/detergent and it is packed for sale

In addition to the described process, detergents usually incorporate a variety of other ingredients that act as water softeners, free-flowing agents, etc.

The chemistry of detergents
All detergents contain a surfactant as their active ingredient. This is ionic species consisting of a long, linear, non-polar 'tail' with a cationic or anionic 'head' and a counter ion. The tail is water insoluble and the head is water soluble – a difference in solubility which has two important implications. Firstly, this makes the surfactant molecule a wetting agent: the tails migrate to align themselves with the solid: water interface, lowering the surface tension at that point so that it penetrates the fabric better. Secondly, it allows the oily dirt particles to form an emulsion with the water: the tails of may surfactant molecules surround an doily dirt particle, forming a micelle with a drop of oil in the centre and the ionic heads of the surfactant molecules pointing outwards and hence keeping the micelle in the polar solution.

The detergent manufacturing process
Detergents use a synthetic surfactant in most of the cases, instead of the metal fatty acid salts. They are made both in powder and liquid from, and sold as laundry powders, hard surface cleaners, dish washing liquids, fabric conditioners, etc. most detergents have soap in their mixture of ingredients, but it usually functions more as a foam depressant than as a surfactant.

Detergent powder manufacture

Step 1 – slurry making
The solid and liquid raw ingredients (see table xx) are dropped into a large tank know as a slurry mixer. As the ingredients are added the mixture heats up as a result of two exothermic reaction: the hydration of sodium tripolyphosphate and the reaction between caustic soda and linear alkylbezenesulphonic acid. The mixture is then further heated to 85C and stirred until it forms homogenous slurry.

Step 2 – spray drying
The slurry is de-aerated in a vacuum chamber and the then separated by an atomiser into finely divided droplets. These are sprayed into a column of air at 425C, where they dry instantaneously. The resultant powder is known as 'base powder' and its extract treatment form this point on depends on the product being made.

Step 3 post dosing
Other ingredients are now added, and the air blown through the mixture in a fluidiser to mix them into a homogenous powder. Typical ingredients are listed in Table xx.

Table 50: the ingredients of detergent base powder

Solids	
Ingredient	**Function**
Sodium tripolyphosphate (STP)	Water softener, ph buffer (to reduce alkalinity)
Sodium sulphate	Bulking and free-flowing agent
Soap noodles	Causes rapid foam collapse during rinsing
Zeolite	Water softener (adsorbs Ca2+ and Mg2+) in countries where STP is not used. Granulating agent for concentrated detergents
Sodium carboxymethyl cellulose	Increases the negative charge on cellulosic fibres such as cotton and rayon, causing them to repel dirt particles (which are positively charged)
Liquids	
Linear alkylbenzene sulphonic acid (LAS)	Surfactant – the main active ingredient
Caustic soda solution	Neutralises the LAS
Coconut diethanolamide or a fatty alcohol ethoxylate	Non-ionic detergent and foam former
Fluorescer	Absorbs UV light and emits blue light, causing ageing cotton to appear white rather than yellow
Water	Dissolves the various ingredients, causing them to mix better

<u>Liquid detergent manufacture</u>

Step 1 soap premix manufacture
Liquid detergent contains soap as well as synthetic surfactants. This is usually made first as a premix, and then other ingredients are blended into it. This step simply consists of neutralising fatty acids (rather than fats themselves) with either caustic soda (NaOH) or potassium hydroxide.

Step 2 – ingredient mixing
All ingredients expect enzymes are added and mixed at high temperature. The ingredients used in liquid detergent manufacture are typically sodium tripolyphosphate, caustic soda, sulphonic acid, perfume and water. The function of these ingredients has been covered above.

Step 3 – enzyme addition
The mixture is cooled and milled and the enzymes added in powder form.

Table 51: typical post dosing ingredients

Ingredient	**Function**
Soda ash (anhydrous Na_2CO_3)	Keeps the pH at 9.0-9.5. This ensures optimum detergent function. Also forms insoluble carbonates with Ca and Mg, so acts as a water softener
Bleach (usually sodium perborate) $NaBO_3$	Bleaches stains without damaging colour fast dyes. Sodium perborate breaks down at high temperatures to release H_2O_2, which functions this way
Bleach activator (e.g. tetraacetylethylenediamine)	Catalyses sodium perborate breakdown at low temperatures
Enzymes (e.g. alkaline protease)	Alkaline protease breaks down proteins in the alkaline conditions created by soda ash, helping to remove stains
Colour and perfume	Create a more aesthetically pleasing product.

Environmental implications of the production process

Soap is designed as a product to be used once then flushed down the drain, so as expected the environmental implications of its manufacture are not nearly so great as many other chemical processes. There are two min areas of concern: the safe transport and containment of the raw materials and the minimization of losses during manufacture.

The three main components of detergents by both cost and volume are oils, caustic and perfumes. Oils and perfume are immiscible in water and if spilled create havoc, although the oils do solidify at room temperature. Transport of these products is by trained carriers and the systems for pumping from the truck to storage tanks are carefully designed. Perfumes are bought in lined steel drums which are quite robust and flammable perfumes are not used in soaps.

All storage tanks are surrounded by bunds to catch the contents of a tank should it rupture or a valve fail. When the storage system is designed, all the safety features (such as access to tank and valves) are designed in, as well as procedures to deal with the product should it end up in a bunded area. Within the plant, all the process areas are also bunded, and the trade waste from the piped to the interception tank before draining to the council's trade waster system. The contents of the interception tank are continuously monitored for acidity or alkalinity, and are designed to settle out excess solids or light phase chemicals. If a spill is detected in the plant itself, a portion of the interception tank can be isolated off and the effects of the spill neutralised before the waste is dumped.

In most cases, however, potential problems are identified and stopped before they happen. Often an off-spec product can be reprocessed and blended rather than dumped, and even washout water can be reprocessed to minimise the discharges from the plant.

Finally, the manufacturing process itself is closely monitored to ensure any losses are kept to a minimum. Continuous measurements of key properties such as electrolyte levels and moisture both ensure that he final product is being made to spec, and ensures the manufacturing process is working as it was designed to. Hence the losses in the plant will indirectly be minimised because the process itself is being monitored.

Synthetic detergent biodegradability

There has recently been a strong move away from the environmentally hazardous biologically stable detergents used in the past to biodegradable ones. The sulphonic acid and non-ionic detergents used to produce both liquid and powder detergents are fully biodegradable (in most cases). The sulphonic acid is made form a highly linear alkylbenzene, mainly dodecylbenxene and the non-ioninc are ethoxylated long chain alcohols. The sodium lauryl ether sulphates also used in liquid detergents and shampoos are highly biodegradable, being made from either natural or synthetic linear C12-C15 alcohols.

Detergent powder

Detergent poweder manufacture has some specific environmental issues associated with it that are not present in other areas of the industry. These are dust control and VOC emissions. Dust present during delivery and transfer of bulk powdered detergent (and powdered raw materials) is a potential problem. Dry and wet cyclones are used to filter out most of the dust, and all emissions are monitored. If the dust level in these does exceed acceptable limits, appropriate remedial action is taken. Dust levels in emissions must be kept below 50 mg/m^3

The spray drying tower also releases VOC. These emissions are minimised by having tight specifications on what can be added as primary detergent active material. Any potentially hazardous materials are added with the secondary actives after the tower so that it is not heated. Spot checks are done on the total hydrocarbon content of the exhausted gases using a flame ionisation detector.