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REACH

CONSUMER SMARTPHONE APPS FOR PROBLEMATIC SUBSTANCES IN PRODUCTS

EMERGENCE AND POTENTIAL IMPACTS

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DARMSTADT, DECEMBER 2018

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Consumer Smartphone Apps for Problematic Substances in Products

Emergence and potential impacts

Vers. 2

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University of Applied Sciences Darmstadt

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The Project "Enabling REACH consumer information rights on chemicals in articles by IT-tools" (LIFE AskREACH, No. LIFE16 GIE/DE/000738) is funded by the LIFE Programme of the European Union

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Abbreviations

App	Smartphone/Mobile application
BUND	Bund für Umwelt und Naturschutz (German Federation for the Environment and Nature)
CLP	(Regulation concerning) Classification, Labelling and Packaging of substances and mixtures
CMR	Carcinogenic, mutagenic and reprotoxic substances
CPG	Consumer packaged goods
CSR	Corporate Social Responsibility
DAU	Daily Active Users
DEHP	Di(2-ethylhexyl)phthalate
ECHA	European Chemicals Agency
ED	Endocrine disrupters
EDC	Endocrine disrupting chemicals
EEA	European Economic Area
EU	European Union
GHS	Globally harmonised system
GSDN	Global Data Synchronisation Network
GTIN	Global trade item number
INCI	International Nomenclature of Cosmetic Ingredients
KPI	Key Performance Indicator
LOHAS	Lifestyle of Health and Sustainability
MAU	Monthly Active Users
NGO	Non-governmental organization
PBT	Persistent, Bioaccumulative and/or Toxic Chemicals
REACH	(Regulation concerning) Registration, Evaluation, Authorization and Restriction of Chemicals
SiA	Substances in Articles
SVHC	Substances of Very High Concern
UL	Underwriters Laboratories
vPvB	Very persistent, very bioaccumulative chemicals

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1 Executive Summary

The AskREACH project develops a smartphone app for consumers to scan article barcodes and immediately receive, or request from the article supplier, information on substances of very high concern (SVHCs) in those articles. This report documents results of

- a screening of existing consumer tools regarding chemical substances in products and
- an analysis of the factors that contribute to the tools' potential impact on consumer behaviour, and, eventually, on company decision making.

The main purpose of this paper is providing insights to the AskREACH app development and implementation.

The screening of consumer tools in 13 EU Member States taking part in the AskREACH project identified 32 relevant EU-based apps, as well as 4 third-country apps. The majority of these tools focus on providing general and product related information about chemicals and their (potential) impacts on human health. Some, in addition, give general and product specific information about (potential) environmental impacts. A few tools compare product prices and give general information on product ingredients, nutritional values, recipes, shopping lists etc.

A literature review identified relevant aspects in terms of influencing consumer behaviour and the potential role of smartphone apps, which subsequently guided the analysis, in addition to some technical questions related to information sources and processing.

Eight tools were analysed. The aim was to address a broad range of tools (e.g. in terms of product and substance focus, or availability in different regions), while reflecting the issues discussed in the literature (e.g. consideration of tools with gamification features). The analysis looked at the following topics:

- Information sources and processing (master data sources, multilingualism)
- Stimulating consumer behaviour (credibility, role of consumer campaigning, app use and user engagement, relevant product categories, strategies of information provision)
- Impact on consumer behaviour
- Impact on company decision-making.

The main conclusions from the analysis of eight selected consumer apps are as follows:

- Data sources and reliability: The usual way to obtain master data is via databases. Most of the content is monitored and kept up-to-date by the tool developer and/or by the database owner. In addition, tools apply different approaches to involving product suppliers and tool users. Suppliers are usually entitled to provide and adjust data about their products. This first-hand information contributes to data reliability. In addition, some tools establish consumer feedback channels. As regards overall credibility of an app, consumers have confidence in information provided by reputable sources. However, suppliers are not regarded as an overly credible source.
- Consumer campaigns can influence consumer motivation with respect to health or environment related issues. They can be applied as a manifestation of the app's goals in the users' local context and they can contribute to keeping the app users engaged. Marketing via social media has proven efficient and social media presence is a prerequisite. However, newspapers and television (still) ensure the greatest outreach. Linking tool-related messages to health issues is an effective way

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to create consumer awareness. Showing how the app's goals and user actions contribute to the "bigger picture", for example sustainable development, is another useful communication strategy. This is backed by Eurobarometer findings, according to which 90% of EU-28 citizens are worried about the impact that chemicals in products can have on the environment – thus exceeding concerns these citizens have regarding their own health (84%). Advertisements and marketing activities have to show up periodically in order to sustain user initiative and enthusiasm. Key target audiences are consumers most interested in a product's potential health impacts (i.e. parents, especially [expectant] mothers, and people living a lifestyle of health and sustainability [LOHAS]), as well as "activists", who can be expected to make many scans.

- Sustained user involvement is pivotal because behavioural change involves breaking existing habits or creating new ones, which is a long-term process. In this respect, ensuring the continued use of a tool once it has been downloaded is challenging. In times of information overload, with a plethora of smartphone apps, the product information provided by such an app may motivate users to "try" it several times. However, when it comes to keeping users engaged over a longer period, analysis shows that tool features are helpful which appeal to the play instincts of the *homo ludens*. Such "gamification" features include reward systems as well as elements of social competition within peer groups, both implying the need for more personalised tool settings. In addition, consumer campaigns can contribute to sustained involvement.
- Most of the screened tools already reflect which product categories are at the focus of consumer interest, i.e. the two broad areas of food and cosmetics. Toys are the third most popular articles that consumers scan.
- Tools must provide information, which is relevant for the consumer, e.g. addressing motivational aspects such as perceived risks. In addition, processing the app and retrieving information has to be convenient. Experience shows that most users want the app to tell them quickly whether to buy a product or to inform about better alternatives. In contrast, only a small proportion are interested in spending extra time on more detailed contents. Consequently, apps have to provide information that is easy to understand and allows quick conclusions to be made. At the same time, information must be very clear about hazards or risks for a product. Displaying health and environmental impact information in a colour-coded system is an established practice (e.g. green and red signs for products). This is a common way to provide information relevant for different consumption contexts at one glimpse, while at the same time more detailed background information on the product evaluation is often only a click away. In addition, some tools also aim to be a "lifestyle adviser", offering contents that go beyond product information.
- Consumer impact: Especially tools applying gamification features have a higher likelihood of sustained consumer use, i.e. checking the tool in the context of everyday consumption decisions becomes a habit. Direct impact of a tool is interrelated with the product range it covers and consumer risk perception in this respect. For example, a survey of users of a cosmetics tool shows that it significantly facilitates identification of problematic substances in cosmetics, so that users do not purchase such products. Besides, there are indications that where tools provide information on alternative products with better performance in terms of health/environment, users tend to prefer these.
- Company impact: Apps can raise companies' awareness on the issue of problematic substances in their products. Notably, they show companies that consumers reject such products. From a product design perspective, impact begins already well before consumers use the app. The mere fact that (well-structured and popular) apps are available can influence company decisions in the process of product design or in the placement of orders. Besides, apps contribute to public pressure

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and to that extent at least have an indirect impact on company decision-making. For ToxFox, a success story in terms of a direct link between tool and company decision-making is reported.

- Apps also yield benefits for companies who can find out about customer concerns and dissatisfaction. Some tools establish a communication channel for companies, giving them the opportunity to get in contact with their customers, for instance by writing about the products origin and "personalizing" the product.

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2 Introduction

This report works up findings of a study focussing on stimulating consumer behaviour in terms of products containing problematic substances via smartphone applications. It presents an overview of existing apps and provides a more thorough analysis of eight smartphone applications. The analysis focusses on how the tools apply strategies to stimulate behavioural changes, and the extent to which they impact on consumer behaviour as well as on company decision making. The findings of the report assist the LIFE AskREACH project, which is developing a smartphone app regarding substances of very high concern in articles. In addition, the report is addressed to competent authorities, organisations aiming at launching similar tools, NGOs that campaign to change consumer behaviour, and companies that want to develop their environmental corporate identity further.

2.1 Context

LIFE AskREACH addresses the "right to know" pursuant to Article 33(2) of the EU chemicals regulation REACH,[1] providing a claim for consumers to ask companies about problematic substances in their products. REACH aims at a high level of protection of human health and the environment.[2] Another objective of REACH is that "EU citizens should have access to information about chemicals to which they may be exposed, in order to allow them to make informed decisions about their use of chemicals".[3] Therefore, REACH Art. 33(2) gives consumers a "right to know" about substances of very high concern (SVHC) in articles (e.g. furniture, textiles, electronics, toys etc.).[4] More specifically, the provision stipulates that on request by a consumer, any supplier of an article containing a SVHC above 0.1 wt% (percentage by weight), shall provide the consumer with sufficient information to allow safe use of the article including, as a minimum, the name of that substance. The relevant information shall be provided, free of charge, within 45 days of receipt of the request. In the words of the European Commission, this provision was included in REACH so "[c]onsumers can play an active role in the process by taking an interest in the safety of the products they buy".[5] Ultimately, the provision can lead to market-induced incentives for article producers to use safer substances or technologies, which is an important objective of REACH.[6] However, consumers need to search for article and contact data, send the request and wait up to 45 days for a response. Therefore, REACH Art. 33(2) by itself lacks practical relevance, because the information is not easy to access at the right time and place. In line with expectations, a 2016 report of the European Chemicals Agency (ECHA) on the operation of REACH found consumers largely unaware of their right to ask for information on SVHCs in articles.[7] Besides, the European Commission observes that companies "struggle" to respond to (the few) consumer requests.[8]

1 Regulation (EC) No 1907/2006, 2006 OJ L 396/1.
2 Führ and Bizer 2007.
3 REACH Recital 117.
4 Cf. section 2.5 for explanations of relevant REACH terms.
5 European Commission 2016.
6 REACH Art. 55, Recital 12, 70.
7 ECHA 2016, 120.
8 European Commission 2018.

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One reason for the latter is the lack of appropriate communication on SVHCs in supply chains:[9] According to REACH Art. 33(1) suppliers have the duty to communicate to the recipient of an article the names of SVHCs present in those articles above 0.1 % with available safe handing information – upon delivery. ECHA reports on "clear indications" that SVHC information is not adequately communicated along the article supply chains.[10] At the same time, if consumers do not ask, an important incentive for supply chain communication is missing.

The LIFE AskREACH project therefore aims to raise the awareness of the consumers about their "right to know" and the awareness of the article suppliers about their "duty to tell" the recipient and consumers on request. To this end, the project is developing a smartphone application that allows consumers to send "right to know" requests after scanning a product's barcode. Answers provided by suppliers are stored in a database and immediately available for future requests. The consumer app should contribute to an increase in information requests as it will motivate the consumer to ask, whereas the database should support companies to efficiently meet this request as their answer will have to be given only once per article, if entered in the database. Other core actions of the project include awareness raising campaigns addressing the consumers and the market actors. The AskREACH app[11] will be available from spring 2019 at first in the 13 EU Member States[12] cooperating in the project. By the end of the project in 2022 it should be available throughout the EU.[13]

2.2 Aim

This report aims to provide an overview of existing consumer apps and their performance in terms of changing consumer behaviour and incentivising changes in product design by article suppliers. It is guided by the following research questions:

- How do existing apps source and process information?
- How can apps stimulate consumer behaviour taking into account problematic substances in articles?
- What are the impacts of existing tools on consumer behaviour?
- What are the impacts of existing tools on company decision-making?

The report thus informs the AskREACH app and campaigning strategy development. Other target groups addressed are competent authorities, organisations aiming at launching similar IT tools, NGOs that campaign to change consumer behaviour and companies that want to develop their environmental corporate identity further.

9 Cf. Reihlen and Halliday, 24.
10 ECHA 2016, 120.
11 Upon publication of the report at hand, the final name of the tool was not decided yet.
12 Austria, Croatia, Czech Republic, Denmark, Germany, France, Greece, Latvia, Luxembourg, Poland, Portugal, Spain, and Sweden.
13 Please refer to www.askreach.eu for more information on the project.

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2.3 Methodology

This report aims to inform the AskREACH app and campaigning strategy development. Besides, the AskREACH project partners were involved in screening existing apps. Therefore, both in terms of scope and methodology, the analysis presented in this report is predetermined by the aims of AskREACH and the composition of the project consortium.

The methods applied comprise four steps, i.e. defining research questions (see section 2.2), literature review, screening of existing tools, and analysis of selected tools.

Literature Review

A concise literature review on consumer behaviour, on consumer attitudes regarding problematic substances in products and on how smartphone applications can reach an impact provides criteria to guide the following assessments steps. This step also forms a theoretical base for the AskREACH app by suggesting features that contribute to the app's objective.

Screening

There are two outcomes of the screening: it shall give an overview of existing IT tools and identify tools relevant for analysis. Project partners looked for existing IT tools for consumer information available in their countries (desk research in app stores and online). In addition, partners reached out to their networks beyond Europe in order to identify tools used in the Americas, Asia and Australia. Smartphone applications and interactive websites available as mobile versions, which relate to chemical substances in products and are available to the general public fall into the scope of the screening. Filling out a questionnaire provided by the authors (Appendix 7.1), partners gathered information between autumn 2017 and spring 2018 on the tools they had identified and proposed for inclusion in the report.

Analysis

The aim of this step is a more thorough analysis of selected tools. Refinement of the research questions (step 1), taking into account findings from a literature review (step 2), yielded criteria for the selection:

- (A) Coverage of problematic substances in (REACH) articles
- (B) Popularity, as indicated by a large number of installations (>100.000 installations[14])
- (C) Gamification features implemented
- (D) Maintaining of (own) database
- (E) Multinational and multilingual performance

Besides, the tool choice takes into account availability in and representation of different AskREACH partner country markets.

Table 1 displays the tools subject to analysis and which selection criteria apply for each tool.

[14] According to information on Google play store.

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Criteria coverage / Tools	Problematic Substances [A]	Popularity [B]	Gamification [C]	Database [D]	Internationality [E]
Abouit	x			x	
CodeCheck	x	x	x	x	x
Detox Me	x		x	x	
Fer Potravina	x	x		x	
GoodGuide	x			x	
Kemiluppen	x	x		x	
Tjek Kemien	x			x	
ToxFox	x	x		x	

Table 1: Tool categorisation to facilitate selection of tools for analysis

The analysis comprises an assessment of the information already provided on the respective tool by partners, additional desk research on the tools, as well as a comprehensive survey of the tool developers during the spring and summer 2018. The questionnaire used for the survey addressed relevant aspects such as consumer campaigning experience, usage of the tool, its impact on consumer consumption behaviour, favoured product categories, the communicated risks/hazards, experience with user engagement strategies, and its impact on company decision-making (Appendixes 7.2 and 7.3).

2.4 Structure

Subsequent to the project introduction follows a literature review about the potential of smartphone applications regarding consumer behaviour in chapter 3. This chapter gives insights as to why and how smartphone applications are able to influence consumer behaviour. Chapter 4 presents the results of the tool analysis. It gives a brief overview of all screened tools and afterwards dives into the analysis of selected tools. The conclusions in chapter 5 summarize the main findings of the analysis.

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2.5 Important terminology used

Article means an object, which, during production, is given a special shape, surface or design, which determines its function to a greater degree than does its chemical composition.[15] Chemicals and mixtures thereof, such as cosmetics or household detergents, are not covered by the article definition and neither is food. All other products fall within its scope.

Developer means the organisation or natural person that has developed and distributes a consumer tool.

Hazard information gives details of the presence of a problematic substance in a product.

Problematic substance means a chemical substance with intrinsic properties that may cause damage to human health and/or the environment. SVHCs fall under the term as well as substances classified as "hazardous" according to the CLP Regulation.[16]

Product is a generic term for all marketed goods, i.e. articles, substances and mixtures, including food and cosmetics.

Producer of an article: means any natural or legal person who makes or assembles an article within the European Union.[17]

Risk information describes the possibility of a problematic substance in a product causing harm to human health or the environment (considering the use conditions of a product).

Supplier of an article means any producer or importer of an article, distributor or other actor in the supply chain placing an article on the market.[18]

SVHCs are legally defined by REACH Article 57 and identified by public authorities in a formalized procedure. SVHCs include substances, which are persistent, bioaccumulative and toxic or very persistent and very bioaccumulative (PBT/vPvB), substances that are carcinogenic, germ cell mutagenic or toxic to the reproductive system (CMR) and substances with properties of equivalent concern, e.g. endocrine disrupters (ED) or respiratory sensitisers. Due to their problematic properties, SVHCs may cause damage to human health, wildlife or the functioning of ecosystems. The group of PBT/vPvB substances are of particular concern for the environment because they persist and accumulate in certain environmental compartments and along the food chain. This is also leading to considerable exposure of humans to SVHCs with potential adverse health effects.

15 REACH Art. 3(3).
16 Regulation (EC) No 1272/2008, 2008 OJ L 353/1.
17 REACH Art. 3(4).
18 REACH Art. 3(33).

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3 Risk awareness, consumer behaviour and smartphone applications – an overview

Consumers would often choose to purchase more ethically preferable products if these were easier to find.[19] Smartphone tools can bridge existing information gaps as they facilitate access to information – and thus reduce consumers' transaction costs. By providing relevant context-specific product information they can reduce information overload[20] of the consumer and thus facilitate navigating through modern risk societies.[21] Apps offer huge potentials to consult users as to a consumption behaviour reducing negative impacts on health and environment. The literature reviews in sections 3.2 and 3.3[22] briefly dwell on consumer behaviour concepts and how smartphone applications can reach an impact. However, apps can only induce behavioural change to the extent that the user already shows some basic motivation in this respect.[23] Section 3.1[24] therefore introduces empirical evidence on one key motivational aspect, i.e. consumer knowledge regarding chemicals in products.

3.1 Consumer knowledge regarding chemicals in products

Among the main environmental issues that people are worried about, chemicals occupy a prominent place in recent years. In fact, according to recent polls of EU citizens (Eurobarometer),[25] the level of concern about chemicals has increased over the past decade. In 2005 and 2008, chemicals were ranked as the fifth environmental concern, rose later to fourth and eventually became the third main concern of European citizens. This increasing trend is not only evident in the average of the 28 EU Member States, but also in each individual partner country. Nevertheless, the importance attributed to chemicals as an environmental concern varies greatly among the partner countries. Some, such as Denmark, Sweden and Greece, consider this an issue of significant focus, while others, like Portugal and Spain, attribute low relevance to chemicals in daily life products (although a distinct inversion of the pattern is observed in the most recent survey).

The importance of the impact that chemicals used in everyday products have on human health was analysed in each individual partner country. Results have shown that for twelve partner countries such a concern is among the five main concerns. It is the second most chosen issue of concern for Sweden and Germany, followed by Greece, France, Latvia, Luxembourg and Denmark where it is third, while in Czech Republic, Poland, Austria and Croatia drops at fourth place. Spain and Portugal fall behind by ranking chemicals as their fifth and sixth main environmental issue of concern, respectively. Even though the percentage may vary among the different surveys, Europeans feel quite clearly they do not know enough about the impact of chemicals in products on their health and that there is a lack of the necessary information as well as accessibility to it.

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19 Horizont 2014.
20 Jacoby 1984, 432-435.
21 Godfrey 2014.
22 The authors would like to thank Rebecca Niebler for her preparatory work on sections 3.2 and 3.3.
23 Dennison 2013, 6.
24 This section is based on extracts from a work prepared by Susana Fonseca, focussing on empirical data relevant for the consumers from AskREACH partner countries (cf. supra note 12).
25 Eurobarometer 2005, 2008, 2011a, 2011b, 2013, 2014, 2015, 2017a, 2017b.

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In a 2017 survey of EU citizens (EU28), 84% said they were worried about the impacts on their health concerning chemicals present in everyday products and 90% were worried about the impact chemicals in products could have on the environment.[26] These results indicate that the environmental impacts of chemicals in daily products warrant a slightly higher concern than the impact on human health.

Regarding the presence of chemicals in everyday products, most of the countries demonstrated a balanced perception of where chemical substances may be found, with the exception of Portugal, Spain, Poland and Greece, whose respondents showed unconcerned about certain product categories, such as clothes/shoes, children's toys, furniture or food and drink.[27]

At the same time, citizens from all partner countries doubt the safety of daily products for human health and the environment, at least to some extent. Five partner countries are clearly positively predisposed, assuming daily products to be safe for human health (Portugal, Sweden, Austria, Denmark and Spain). Citizens in the remaining eight countries are of the opposite opinion. The distrust in the safety of products containing chemicals is exceptionally high in France, Latvia, Croatia and Luxembourg.[28]

3.2 Approaching consumer behaviour

In a product context, consumer behaviour generally refers to purchasing decisions, product use, and disposal or recycling.[29] It is shaped by perceptions and cognitive capabilities of processing information, by habitual behaviour, and by emotional status, attitudes and "lifestyle", which may be linked to demographic factors including social class, religion, and cultural attributes.[30] Besides, to understand and ultimately influence behaviour, the entire institutional context of individuals is relevant, i.e. all formal and informal instructions that can have an effect on behaviour (e.g. fairness rules, exemplified behaviour in peer groups, or rules acquired in the working sphere).[31]

Social psychologists discuss factors that promote or inhibit "pro-environmental" consumer behaviour such as sensitivity with regard to articles with problematic substances. Motivational and contextual factors as well as habitual behaviour are key factors in this respect.[32] Motivational factors take into account perceived benefits and costs associated with a product and also include moral and normative concerns, which play a significant – though not fully understood – role in the decision process regarding pro-environmental behaviour. Contextual factors include technical features (e.g. of a smartphone app) and the availability of products as well as their characteristics. Additionally, responses are often habitual, rather than being based on rational decisions. Habits are formed when acting in a certain way frequently leads to the achievement of certain targets. People then tend to ignore information that is not consistent with their behaviour, and focus on information that confirms

26 Eurobarometer 2017a.
27 According to the Eurobarometer 2013.
28 Eurobarometer 2017b.
29 Trommsdorff & Teichert 2011, 15.
30 Cf. Shareef, Dwivedi, & Kumar 2016, 2. According to the authors, consumer beliefs, attitudes, exposures, attention, perception and motivation towards information and communication technologies are relevant factors, too.
31 Bizer and Führ 2016.
32 Steg & Vlek 2008, 311.

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their choice. Such behaviour may result in misperceptions and selective attention. However, significant changes to the contextual conditions force people to reconsider their habits.[33]

There are two types of intervention strategies aimed at influencing behaviour in a pro-environmental direction, i.e. informal and structural strategies. Informal strategies aim to change motivational factors such as perception, motivation, knowledge and norms. Examples are increasing the consumers' knowledge about environmental problems or influencing their attitude by strengthening ethical or environmental values. Informal strategies are especially successful if the alternative (pro-environmental) behaviour is convenient, not too cost intensive, and if there are no strong barriers to pro-environmental actions. If informal strategies are insufficient, it is necessary to change the conditions under which decisions are made. Structural strategies aim to change contextual factors such as availability and costs, e.g. by providing alternative pro-environmental options or by imposing legal requirements (e.g. taxation, prohibitions).[34]

Strategies must consider that behavioural change is a long-term process and that making pro-environmental behaviour habitual represents a huge challenge.[35]

3.3 Behavioural change through smartphone applications

Digitalization and devices such as smartphones offer opportunities for promoting pro-environmental behaviour using informal strategies. Smartphones are widely distributed: penetration per capita in, e.g. Western Europe is rising rapidly, from 22.7 % in 2011 to a projected 64.7 % in 2017.[36] Statistics from 2017 show that 68% of Austrian and 69% of German adults use smartphones, with acceptance rates increasing quickly.[37]

Smartphones can be used everywhere at any time. In addition, at least in regions with more developed internet infrastructure, smartphones are always connected. Consumers can thus access information "on the go", i.e. at the right time and the right place to facilitate consumption decisions (e.g. at the point of sale). Empirical data shows that consumers can change their purchase intentions if their smartphone provides information about better alternatives available in the vicinity.[38] Connectivity and social media services also allow the user to permanently share information, thus opening channels to influence members of their private or professional peer groups.[39]

Smartphone applications (apps) offer considerable potential in terms of affecting consumer behaviour. Compared to websites, apps are more convenient to use due to optimized intuitive control, faster performance with local data storage, and information that is often available offline. Apps can also give information about where to obtain alternative products, using location-based tracking[40] or product

33 Ibid.
34 Steg & Vlek 2008, 313.
35 CoŞkun & Erbug 2014, 229.
36 Statista 2018.
37 Ibid.
38 CoŞkun & Erbug, 217; Daurer, Molitor, Spann, & Manchanda 2011, 3.
39 Dennison 2013, 2.
40 Cf. Palos-Sanchez, Saura, Reyes-Menendez, Esquivel 2018, 267. Such services can influence consumer behaviour significantly by improving the promotion of a product or company. They also make it possible to gain more knowledge about the consumer and their behaviour.

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information at the point of sale utilizing barcode scanning. In addition, apps allow consumers to track their own behaviour and consumption patterns.[41]

The literature discusses certain aspects of apps which may encourage pro-environmental behaviour. For instance, apps are more useful when they are applicable to personal needs. This can mean they only give the information the user needs to improve their own environmental performance. In addition, information is most relevant to users if it refers to their local context because that makes required behavioural changes more tangible. Another key factor is the source of the app and the information. Users are more willing to change their behaviour if the app is perceived to be from a reputable and legitimate source[42] while in contrast they have relatively little trust in information provided by article suppliers.[43]

Data quality is also important. Information has to be updated on a regular basis. Of the various ways to evaluate the credibility of an app, consumers mostly rely on a friend's recommendation or on comments or reviews by other users (e.g. reviews in app stores).[44]

Considering the challenge of sustaining behavioural change, apps can utilize different strategies. Updates, e.g. via push message to the device, contribute to keeping the user motivated. Customization is another strategy. For instance, users could define certain behavioural goals for themselves while the app tracks their progress. They may then receive rewards for accomplishments.[45] Indeed, elements that make the app use enjoyable can contribute to long-term effects. In the context of "gamification" the literature discusses several tool features, such as:

- Personalized information and guidance: Creating a personal profile and personalizing the product evaluation can create a sense of ownership. Additionally, users prefer to have diverse, tailored information and guidance which can be provided by the app as well as user generated, and shared on the app.
- Rewards: Intangible and tangible rewards when using the app trigger the users' competitive nature, create a sense of empowerment and thus motivate. After reaching a certain level, intangible rewards can be for example instant feedback when scanning a product, text feedback and badges, progress indicators such as levels one can unlock. Tangible rewards are physical presents (e.g. a T-shirt). Occasional reward pop-ups after scanning a product create a sense of unpredictability and can make the user want to use the app more.[46]
- Social influence and competition: Sharing behavioural data with others on social media platforms provides motivation to improve and to continue using the app. For instance, brag buttons can be used to share scans and scan results with friends and relations.
- Reminders: Reminder functions can be useful to encourage the app use.
- Create a sense of meaning: Quick tutorials to explain the app's purpose, the scanning process and the results, make it easier to start using the app.[47]

41 Dennison 2013, 2; Daurer, Molitor, Spann, & Manchanda 2011, 3.
42 Dennison 2013, 7.
43 Hartmann and Klaschka 2017.
44 Peng et al. 2016, 7.
45 CoŞkun & Erbug 2014, 229.
46 Chou 2015.
47 Coskun and Erbug 2014, 218; Peng et al. 2016, 5.

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3.4 Conclusions

Consumers are concerned with the impacts of chemicals in everyday products on their health and on the environment. Interest in having more information about the presence of chemicals in products is high. At the same time, research indicates smartphone applications have huge potential to stimulate behavioural change in terms of making purchase decisions that limit impacts on health and the environment. This conclusion summarizes several aspects discussed in the literature that are relevant when developing such tools and related campaigns:

Smartphone applications are attractive for consumers if they provide information that is relevant, e.g. about perceived risks. In addition, consumers find apps most useful when they fit in the consumer's local context, e.g. allowing more informed purchasing decisions. Consumers are most interested in getting the information they need e.g. to improve the own environmental performance. Furthermore, processing the app and retrieving information has to be convenient.

In addition, users must have confidence in the app. Apps gain credibility when they (1) are provided by reputable and legitimate sources, (2) provide reliable and correct data, and (3) are recommended by other users. Furthermore, only long-term app utilization leads to sustained behavioural change, which often implies putting aside or adapting certain habits. User involvement strategies can contribute to these long-term effects, for example with personalized information and guidance, rewards, social influence, competition, and reminders.

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4 Analysis

This chapter presents the findings from the analysis of several existing consumer apps addressing problematic substances in products. The overall goal is to provide input for the design and implementation of the AskREACH app. Factors stimulating consumer behaviour as identified in the literature review guided the analysis, as well as some technical challenges related to information sources and processing (see methods in section 2.3).

First, section 4.1 gives an overview of all apps screened for this report. Section 4.2 addresses sources of information and processing. Section 4.3 focusses on strategies of existing tools on how to stimulate consumer behaviour, e.g. by equipping tools with specific functionalities. Finally, sections 4.4 and 4.5 concern the extent to which tools may affect consumer behaviour and the decision-making of market actors. The analysis identified some "good practices", which are highlighted in the relevant sections.

4.1 IT-tool screening

This section provides an overview of all screened tools as well as short descriptions of the analysed tools.

4.1.1 Overview of all screened tools

The following sub-sections present the general screening results and give brief introductions to the tools, which are part of the analysis.

The screening (section 2.3) yielded a range of tools in Europe that focus on highlighting chemical substances in products. The following list outlines general findings from the screening. Appendix 7.4 presents more detailed information on each tool.

Tools and their origins:	• The search yielded 32 tools[48] from Europe suitable for the analysis • In addition, the report takes into account four apps from the U.S. and South Korea
Type of application:	• 24 tools are available as smartphone applications • 8 tools are available as smartphone application and as a website • 4 tools are available as websites (enhanced for mobile phones)
Main purpose & specification of information:	• The majority of the tools focus on providing general and product related information about potential impacts on human health • Some give general and product specific information about potential impacts on human health and the environment • No tool focuses only on giving information about potential impacts on the environment • A few tools are intended to - compare product prices

[48] Other tools with nearly identical design and purpose (such as providing information on E-additives in food) are not considered in this report.

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	- give general information on product ingredients, nutritional values (carbs, proteins, fat, calories), recipes, shopping lists
Product categories	• 33 tools focus on food and/or cosmetic products • 13 tools cover REACH articles[49] • 8 tools include household chemicals or detergents • 1 tool specializes on industry chemicals
Operation	• Most tools process consumer scans of the product barcode and/or offer a search function for the product name, brand or certain ingredients • A few tools can process pictures of a product's ingredient list • One tool offers a speech recognition function to process requests.
Costs	• All tools are free of charge. Some tools offer in-app purchases for premium versions
Distribution	• Most of the tools have restricted themselves to a single national market, meaning they provide information concerning the products available on that national market. • Accordingly, the majority of tools offer a single language
Additional features	• 20 of 36 applications show product pictures • One third provides information on alternative products • One third offers feedback mechanisms or shows product related consumer reviews • 7 tools allow personalised profile and search requests

Table 2: Overview of screening results

4.1.2 Brief introduction of analysed tools

Eight tools were selected for analysis. The selection (see section 2.3) aimed to include all types of screened tools (e.g. in terms of product and substance focus, or availability in different regions) and reflected the aspects discussed in literature (e.g. consideration of tools with gamification features). In most cases, communication relates to the presence or absence of substances. According to a European Commission report on tracking tools for substances in articles, consumer apps support communications in either "both directions (consumer request and company answer), or only one direction (either only consumer request or proactive information provision by companies)".[50] The selected tools allow communications in two directions, since consumers can request information, and suppliers can include information about their products in the database. If the suppliers do not directly provide information, it is made available from legally required product labels.

Fer Potravina

Fer Potravina is a Czech non-profit organization which evaluates the contents and quality of food. [51] Fer Potravina offers a website and a mobile application for food products. According to own

[49] That does not mean these tools inform about SVHCs in articles.
[50] Reihlen and Halliday 2017, 57.
[51] FÉR Potravina 2018a.

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statements, it has the largest database in the Czech Republic.[52] It provides information about general and product-specific hazards to human health from E-additives in food.[53]

Kemiluppen

Kemiluppen is a Danish app designed to avoid problematic substances in cosmetics and personal care products. It checks ingredient lists mainly for substances known or suspected to have an impact on health, such as endocrine-disruptive, carcinogenic and allergenic substances, but also gives information on substances, which may harm the environment.[54] The Danish Consumer Council (Forbrugerrådet Tænk) developed Kemiluppen.

Tjek Kemien

Tjek Kemien is a Danish app developed by the Danish Consumer Council and supported by the Danish Environmental Protection Agency.[55] Tjek Kemien gives general and product specific information about substances of very high concern (SVHCs) in articles under the REACH Regulation that are known to cause harm to human health and the environment. To this end, it facilitates communications between consumers and article suppliers as regards the consumer right to know pursuant to REACH Art. 33 (2). Answers provided by suppliers are collected in a database and are available for future consumer requests.

ToxFox

ToxFox is an app developed by BUND (the German branch of Friends of the Earth). The app provides general and product specific information about endocrine disrupting chemicals in cosmetic products and SVHCs in articles just as Tjek Kemien, ToxFox supports consumers in exercising their right to know.

Abouit

Abouit is a private Spanish company that provides an app and website to support consumer purchasing decisions. It gives information about substances problematic for human health in food and cosmetic products. Additionally, it evaluates the producers' or suppliers' performance in environmental and societal engagement of cosmetic, food, household chemicals/detergents and REACH articles.

GoodGuide

GoodGuide offers an app and a website where it provides product evaluations for cosmetic and household products. It gives general and product specific information about substances problematic for human health in products. GoodGuide belongs to Underwriters Laboratories (UL), a safety consulting and certification company.

Detox Me

Detox Me is an American app, developed by Silent Spring Institute. Detox Me guides consumers through the process of removing problematic substances from their daily lives. It provides research-

52 FÉR Potravina 2018b.
53 FÉR Potravina 2018c.
54 Søndergaard 2018.
55 Forbrugerrådet Tænk Kemi 2018.

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based tips for choosing safer products. Detox Me does not provide product-specific information, but gives general information for cosmetics, food, household chemicals/detergents and REACH articles.

CodeCheck

CodeCheck is a Swiss website and app developed by CodeCheck AG. It provides general and product specific information about cosmetics, food, household chemicals/detergents and REACH articles. The scope covers substances that are problematic for human health and the environment. In addition, it gives lifestyle tips for minimizing negative impacts on health and the environment.

4.2 Information sources and processing

Eventually, the AskREACH app is to be available and applicable throughout the EU. From this, challenges arise in terms of the data sourcing and translation processes. The following sections therefore examine the analysed apps in respect of their data sourcing process and multilingual solutions.

4.2.1 Product data sources

Smartphone apps can facilitate information exchange about problematic substances in products. In order to make this process convenient for users, apps should be connected to a product database, so that users have direct and immediate access to the information.[56] All of the tools analysed here are connected to a product database. Developers of these tools reported several sources for article master data (product code, name, producer, brand, etc.), such as:

- **UL WERCsmart**, focussing on "formulated products" and providing a platform to connect producers with retailers to meet critical compliance and safety needs,[57]
- **MINTEL GNPD** (Global New Products Database), which is marketing-oriented and tracks success of new consumer packaged goods (CPGs) in 62 countries,[58]
- **1WorldSync** product information platform,[59] jointly owned by GS1 Germany and GS1 United States, maintains data of 13.5 million products in 68 countries allocated to 25,000 brands and retailers, while at the same time providing 22 million GTINs (Global Trade Item Numbers), one instance of the GSDN (Global Data Synchronisation Network),
- **ItemMaster**, US based data management platform for consumer packaged goods.[60]

For products that are not yet included in the master database, consumer involvement can be another way of obtaining product related data. When consumers request information on products that are not included, the app asks them to type in data provided on the product packaging (declarations on cosmetics and food). ToxFox and Tjek Kemien facilitate consumer requests to article suppliers and populate their databases with the suppliers' responses. However, experience in Denmark has shown that a lot of companies reply directly to the Tjek Kemien users without copying the app developer in the reply, thus bypassing the database.

56 Reihlen and Halliday, 59.
57 UL Information and Insights Inc. 2018.
58 Mintel Group Ltd. 2018.
59 1WorldSync 2018.
60 Itemmaster 2018.

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Where tool users are entitled to add or update information, suppliers can do so as well. To this end, they may simply create a supplier-user account. In addition, some tools offer more sophisticated input options for suppliers, e.g. allowing for the upload of entire barcode series. However, suppliers use such options rather reluctantly. Moreover, some developers extract product related information (especially for food and cosmetic products) from documents provided by manufacturers or from publicly available and reliable databases.

Finally, as an alternative to the usual way of obtaining master data, the "WikiFood" app is an example of a more collaborative scheme for maintaining product related information. WikiFood members set up and maintain the database themselves. Article authors who enter product information are registered. It is the community's business to control and assess the published product information. Information from manufacturers is marked and cannot be changed by third parties.[61]

Data availability can also become relevant in terms of consumer motivation. Is plausible to assume that failed scan attempts due to lack of product master data lower the motivation for further tool use.

4.2.2 Multilingual versions and multinational data sources

Developing an app for all EU Member States entails the need for multilingualism and obtaining data from multinational data sources. These requirements challenge the information sourcing process in terms of availability of article master data, data reliability, and data liability.

Developers of most of the tools analysed here restricted the applicability to one single national market, as establishing product data scraping systems for multiple product inventories and languages is a complex task. In contrast, the "CodeCheck" app addresses consumers in the various German-speaking countries and therefore gathers information from several country-specific databases and feeds the data into its own database.

When offering one app for an international market with more than one language, settings by the app developer in the app store determine the countries where the app is available for download and use. The localisation process, in contrast, is done in the coding of the app itself, using what is basically a dictionary. The tool developer deposits a key for each multilingual subject and defines the favoured values (translations). After the app installation, it screens the user's smartphone default language settings to decide in what language to operate—if the app is available in the user's default language, it loads that language. Otherwise, it loads the app's default language.

4.2.3 Limitations

GTIN limitations

Apps usually support scanning of products, which carry a GTIN (Global Trade Item Number). GTIN is the global standard product identifier administered by the international (private) organisation GS1. In the retail trade, GTIN is the dominant system, while some major companies with their own retail outlets (e.g. Aldi, H&M, Ikea) apply proprietary systems.

The analysis of the ToxFox showed limitations of the GTIN system when it comes to unambiguous identification of products. There are several reasons for this: firstly, suppliers sometimes assign the

[61] Luxembourg Institute of Science and Technology 2010.

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same GTIN to whole groups of articles, e.g. in the case of fast changing collections.[62] Secondly, and more importantly, specimens of the same article may originate from different production batches. For each batch, there can be different actors and process steps in the supply chain. This in turn may result in differing chemical compositions of articles, which may or may not trigger the Art. 33 REACH information obligations. However, the "GTIN Management Standard" states that only changes to the product formulation that affect the legally required declarable information on the packaging of a product require a new GTIN.[63] According to feedback from industry representatives on a workshop on ToxFox, it is therefore not common practice to assign an individual GTIN to each batch.[64]

Each of the analysed tools allows barcode scanning. Probably being aware of the lack of a centralised coding system for products, most app developers additionally offer search functions within the app. When it comes to unambiguous product results, users have still the option to search for a product name. Kemiluppen offers another alternative to barcode scanning – this app is able to process pictures of a product's ingredient list (chapter 4.3.1).

Supplier identification

Information on the identity and contact details of article suppliers is most important for tools like ToxFox and Tjek Kemien, which support two-way communication (consumer's request and supplier's response). ToxFox and Tjek Kemien merely facilitate communication between consumers and article suppliers, thus calling for accurate supplier identification. After extracting the article's GTIN via barcode scan, the tools identify the owner of the GTIN, listed in the GEPIR database (Global Electronic Party Information Registry) of GS1. However, GEPIR data is often not properly maintained by article suppliers. Consequently, the tools cannot always identify a supplier connected to a given GTIN. If this is the case, consumer requests come to a dead end and cannot be answered. Besides, to the extent that contact data is available, this often leads to individuals in the supplier companies in charge of logistics who are not experts for REACH compliance.

In contrast, experience of the Tjek Kemien developers in Denmark shows that the GTIN performance can be improved by involving GS1 in the project. GS1 agreed to gradually detect and amend wrong information; very few cases are known in which a supplier could not be identified.

If the "barcode owner" is located outside the geographic jurisdiction of REACH, i.e. outside the European Economic Area (EEA), it beyond reach for enforcement measures and therefore may lack incentives to provide the requested data. These actors often may simply ignore any incoming requests. Due to the high proportion of imported articles on the EU markets, this omission is highly relevant. For instance, according to Eurostat data, products worth more than EUR 3 trillion were produced and sold within the EU market in 2015, but products worth more than EUR 1.7 trillion were imported into the EU-28 from third countries. A large proportion of these products are articles in terms of REACH.[65]

62 Klaschka 2017, 24.
63 GS1 AISBL 2016.
64 Schenten 2017.
65 Schenten and Führ 2016.

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4.3 Stimulating consumer behaviour

Consumer apps can stimulate pro-environmental behaviour when they are credible, provide useful information in a simple language, and ensure long-term user involvement.

4.3.1 Credibility, reliability and data quality

Apps gain credibility when consumers perceive the developers as reputable and legitimate sources of reliable data. These aspects lead to the following questions:

- Who is the tool developer?
- What is the app's underlying purpose?
- How do developers ensure reliable data?
- How do users assess the app?

Five of the analysed tools ("ToxFox", "Kemiluppen", "Tjek Kemien", "Detox Me", and "Fer Potravina") are developed and owned by NGOs or government organisations that are experienced within the scope of the application. "CodeCheck" is an unlisted corporation. "GoodGuide" is an incorporation developed by University of California, Berkeley and now belongs to Underwriters Laboratories (UL) Environment, whereby this information is not easily accessible. "Abouit" is a private company owned by private persons. Most importantly, none of the apps is provided by a company trying to push its own products.

In terms of an "underlying purpose", apps refer to legal disclosure obligations. Apps applicable to cosmetics can draw on obligations for producers and suppliers to declare ingredients on the packaging under the EU Regulation on cosmetic products (INCI List). Apps with a food scope use information available on the product packaging as stipulated by the EU regulations on food additives (EC 1333/2008) and food labelling (EU 1169/2011). Other apps refer to the "Classification, Labelling and Packaging" (CLP) Regulation (EC) 1272/2008, which is based on the United Nation's Globally Harmonised System (GHS). The REACH Regulation (EC) 1907/2006 is the basis for ToxFox and Tjek Kemien. Both tools directly focus the right to know pursuant to REACH Art. 33(2) and support consumer requests to article suppliers about the presence of substances of very high concern (SVHCs).

As for data reliability, quality control processes for correct data are mostly based on collaboration between developers and the producers/suppliers; consumer feedback channels are also established. As an example, some developers require users to take pictures of the ingredient lists and then send the product ingredients to the producers for review. Other tools allow direct picture uploads and use algorithms that evaluate the photo quality. Regarding manually entered user submissions, some developers examine the product name and category and use web searches based on the barcodes for plausibility checks if there are any obvious mistakes. Generally, the tool developer and/or the database owner monitors and updates most of the content. Some tool developers go to stores and check whether the products notified by consumers are actually on sale. Some seek to minimise the risk of errors/incorrect data by sending the product information periodically for a check to the producers.

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The Kemiluppen app for instance allows direct picture upload of a product's ingredient list. That way, it not only ensures correct and up-to-date information, it also avoids problems connected to the GTIN limitations, as explained in section 4.2.3.

The methodologies behind the product evaluations are often very complexe. Still, transparency about the methodology can reinforce users' trust into the application. Especially Abouit, GoodGuide and CodeCheck provide easily accessible and comprehensive information on their websites, about the product evaluation methodology and the respective data sources.

Looking at reviews users leave in app stores, regarding the tool itself, many find the screened tools helpful. When comparing user reviews of the analysed tools in the Google Play store, CodeCheck stands out as the highest rated app, with a score of 4.6 out of 5 points. The score, which is based on 29,995 user reviews, gives the app additional credibility and confirms its usefulness.[66]

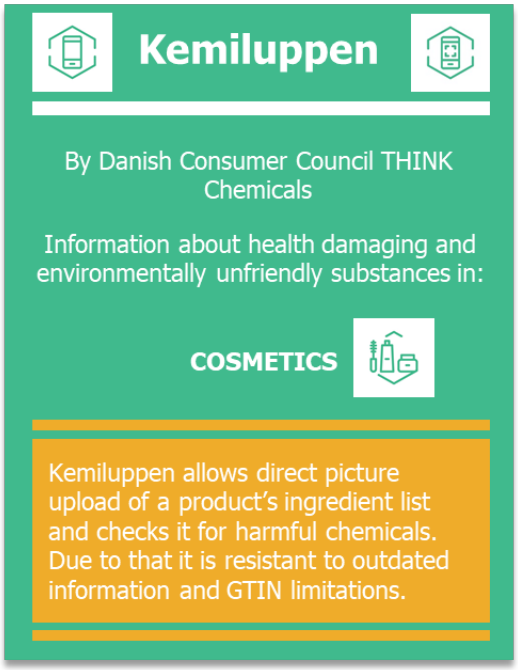

Figure 1: Good practice – Kemiluppen (Source: Own figure)

4.3.2 Consumer campaigning

Considering the results from the literature review, consumer campaigns can influence consumer motivation with respect to health or environment related issues, they can be applied as a manifestation of the app's goals in the users' local context and they can contribute to keeping the app users involved. This section assesses campaigns accompanying the tools.

One of the first steps of consumer campaign development is the definition of one or more **target groups** whose needs and concerns are analysed and then addressed. Developers of the screened apps mostly address the same target groups of aware consumers using very similar approaches. The majority of the developers name parents as their primary and most committed addressees, especially expectant mothers, as well as people living lifestyles of health and sustainability (LOHAS), who are mostly interested in a product's potential health impacts. In addition, consumers who are concerned about effects on the environment are targets, as well as activists. CodeCheck describes its community as conscious consumers who wish to consume sustainably. The majority are women (70%) aged 25 to 34. The aware consumers are well educated, internet oriented, and live in conurbations.[67] According to further feedback from developers, activists are an important audience, because they are intrinsically motivated and make many scans, thus contributing to the tool's success. Since awareness raising is also an educational issue, schoolteachers and teenagers are also targeted directly.

Marketing activities predominately use social media to approach consumers. Platforms such as Facebook, Twitter, Instagram and Pinterest are used either to publish self-generated content (owned)

66 Section 4.4 looks at the reviews from content side.
67 CodeCheck 2018a.

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or to spread media articles about the tool (earned), as well as to share external content relevant for the tool. Social media channels serve as the basis for promoting the application with advertisements. Facebook offers the so-called "boost post" to business pages, which allows tool developers such as the Silent Spring Institute (Detox Me App) to reach an audience beyond the subscribed audience and facilitates specific targeted marketing activities[68]. Other channels include blogs and the cooperation with influencers. However, according to the developers, marketing activities via newspapers and television (still) ensure the greatest outreach. For instance, download peaks of the "ToxFox" can be linked to media coverage of the app. Another way of approaching target groups is by collaborating with other organisations that distribute information (e.g. leaflets) about the app or host web links to the app on their website. The survey revealed no coherent intervals for marketing activities. Some tool developers advertise when the tool is updated or when new features have been incorporated. Others use automated Facebook ads or do not advertise it at all. Developers of several apps defined intervals of their marketing activities. To give some examples: While the ToxFox app is advertised quarterly by social media and newsletters for members, CodeCheck sends push-messages with articles from their own newsfeed twice a week. Similarly, Fer Potravina advertises the tool seven times a week through social networks.

As for **narratives**, the developers report that communicating potential health issues is the most effective way to gain the attention of the general public. For instance, a survey of ToxFox users found them most strongly driven by worries about the effects of SVHCs on their health. About 67% strongly agree with the statement "I sent a consumer request because I worry about the effects of substances of very high concern on my health". However, respondents seem also to be driven by worries about the effects of SVHCs on the environment (53% strongly agree) and a desire to contribute data for the benefit of others (49% strongly agree).[69] In fact, the Eurobarometer polls found that respondents were more worried about the environmental effects than their health when it comes to the impacts of chemicals in everyday products.[70]

According to the tool developer survey, issues of social responsibility related to the environment or supply chain management as such do not attract a lot of interest. In doubt about consumer motivation, tool campaigning can be successful when it conveys to consumers the impression that they are a part of something larger, i.e. that their contribution is good for themselves and the environment. To this end, marketing activities must provide convincing narratives linking social responsibility to the individual consumer situation. CodeCheck conducted a consumer campaign in 2017 advertising its updated personalisation features. They linked supposedly harmless consumption habits with ordinary to severe environmental problems.[71] The slogans have transmitted educational and provocative messages at the same time, since they uncovered the contradictory and illogical behaviour of people who claim to be conscious consumers. The provocation probably contributed to the campaign's success in gaining attention for the app.

68 Facebook 2018.
69 Brenig 2018.
70 Cf. section 3.1.
71 Grammes 2017.

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4.3.3 Tool use and user involvement

Sustained behavioural change, due to an app, is the result of a long-term and rather steady app use. The flow of consumer requests can eventually create a long-term market pull. With a view to the analysed apps, the numbers of active users vary considerably between the tools. Table 1 displays the key performance indicators (KPI) "daily active users" (DAU) and "monthly active users" (MAU) of three of the analysed tools.[72] These KPIs express the number of unique active users over the course of a single day and month (30 days).[73]

Tool use	Tool 1		Tool 2		Tool 3	
Total amount of installations	25,000	100%	76,500	100%	14,000	100%
Daily active users (DAU)	750	3%	389	1%	7.5	0.1%
Monthly active users (MAU)	15,000	60%	3,430	4%	225	2%

Table 3: Tool use

While 60% of the users, as measured by the total amount of installations of tool 1, are active at least once a month, only 4%, respectively 2% are of tools 2 and 3.

The analysis could not clearly identify single factors that are linked to the significant variations between the usages of the tools. While tool 1 claims to keep marketing activities at a very low level only using social media presence, tool 2 is actively approaching its target audiences via several channels such as social media newspapers, journals and events. Tool 3 got media presence in national television after the app's launching but since then never advertised the app again.

More significantly than the MAU ratio, in regard to the apps' main objective (stimulating behavioural change) is the DAU/MAU-ratio - a key indicator, which displays the users' "stickiness" over a 30-day period. More precisely, it indicates how many of the users come back to the app on how many days of a month. Due to that, it correlates with the app's success.[74] User engagement strategies (section 3.3) support and increase the user stickiness. Successful user engagement strategies include personalized information and guidance, rewards, social competition, reminders as well as creating a sense of meaning. Nevertheless, consumers' general risk perception, namely the perceived higher impacts of chemicals in everyday products (food, cosmetics, clothes) on health and on the environment can influence the stickiness-ratio.

72 Although the tools' scopes are not entirely the same, comparability is given.
73 Yongwen 2012, 23.
74 Ibid.

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Less than half of the eight analysed tools offer options to personalize the profile and thus information and guidance, while "Detox Me" and "Codecheck" certainly stand out. One third of the analysed tools allow product related and user generated feedback, which is shared on the app. Through text reviews or ratings such as thumb up or down, users share and receive a personal product evaluation. In this regard, "CodeCheck" offers feedback mechanisms to consumers.

Regarding reward systems, more than half of the tools cover intangible reward features like instant feedback mechanisms, after a user scanned a product or interacted with the app. The feedback can be a simple "Thank you" or a short interaction with the user, e.g. short questions about how/if the user liked the product, for instance. None of the analysed tools offer tangible rewards. Fifty per cent of the tools consider social influence and social competition as an important user engagement feature and incorporate brag buttons or other social sharing functions into the app. Only Detox Me applies reminder functions that encourage utilization of the tool.

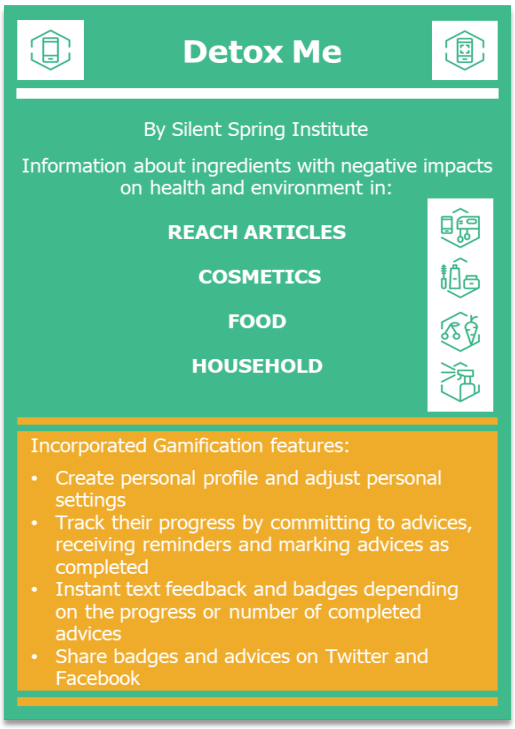

Figure 2: Good practice - Detox Me (Source: Own figure)

Detox Me and CodeCheck are two "good practice" tools, for the following reasons.

The US based tool Detox Me covers many of the mentioned gamification features for user involvement. Users can create a personal profile and adjust their settings of the order in which "detox advices" appear. Additionally, users can track their progress, receiving reminders and marking advice as completed. The app provides intangible rewards like instant text feedback and badges depending on the progress. In addition, users may share badges and advice on Twitter and Facebook and thus create social competition

With regard to personalised information and guidance, "CodeCheck" offers various features, based on the user's individual needs and interests. As part of the app's settings, users can personalise the product evaluation. For instance, in terms of nutrition facts, users can choose their preferred amounts of sugar, fats, salts, etc. in products. Additionally, users can enter lifestyle parameters such as vegan, vegetarian or gluten-free diet.

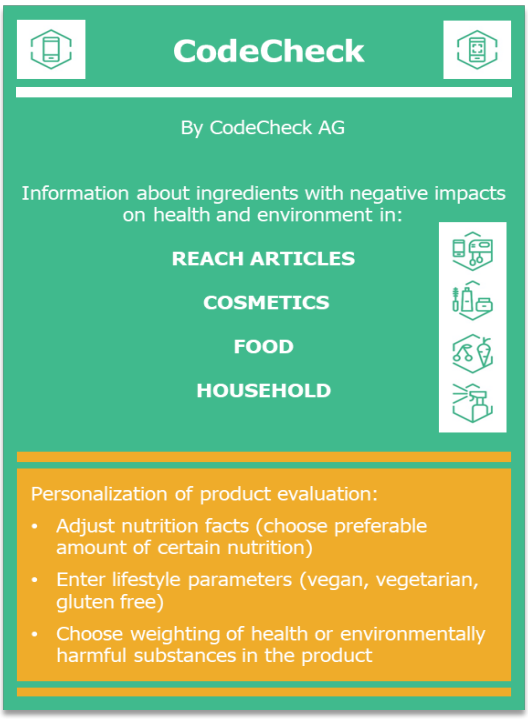

Figure 3: Good practice - CodeCheck (1) (Source: Own figure)

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Moreover, the settings give the option to put more weight to substances relevant for health and/or environment in their product. The personalised evaluation gives an overall estimate as to whether the product is suitable, based on the user settings and weightings. According to the customized evaluation process, CodeCheck offers tailored (lifestyle) information beyond the generic product information. Further user engagement strategies applied by CodeCheck include the "Top 10 CodeChecker", an intangible reward system. Registered users are displayed in a separate section on the CodeCheck website, based on the sum of the monthly scanned products.[75]

Furthermore, the CodeCheck tool offers consumers many feedback options. Beside the tool's own product evaluation, it allows users to comment on advantages and disadvantages of a scanned product. Moreover, other users have the option to agree or disagree with these reviews. The comments most users agreed with are shown at the top of the feedbacks. Mainly, consumers assess the products according to effectiveness, appearance, flavour, or durability.

Figure 4: Good practice - CodeCheck (2) (Source: Own figure)

It should also be noted that ToxFox and TjekKemien pursue a user engagement strategy, which is determined by the tool functionalities: both tools need involvement to build up the SVHC database, and ToxFox, in addition, allows consumers to send product-specific protest mails. Users therefore turn from passive information receivers to "activists", requesting information from article suppliers or communicating that they are not in agreement with suppliers' business conduct. The involvement strategies involve altruistic narratives explicitly addressing this issue. For example, in a survey of ToxFox users, interviewees express a desire to contribute data for the benefit of others (section 4.3.2).

Coming back to the initially mentioned examples for tool use (Table 3), it can be noted that according to their own statements, tool 1 and 3 hardly offer any of the recommended user engagement strategies, whereas tool 2 features many of them. However, tool 1 seems to have the highest (unique) MAU in relation to its total installations. But looking at the user stickiness (DAU/MAU – ratio), tool 2 does better than tool 1 (Table 4). It is plausible that the efforts put into user involvement features by tool 2 pay off. Table 4 shows a DAU/MAU-ratio of 11% for tool 2, which means the average user uses the app 3.3 days a month. In contrast, the average user of tool 1 uses it 1.5 days a month. That implies that by applying gamification features, tool 2 extends the time users spend using the app, consequently increasing the potential to stimulate pro-environmental behaviour.

75 CodeCheck AG 2018c.

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	Tool 1		Tool 2		Tool 3	
DAU/MAU	5%	1.5 d/month	11%	3.3 d/month	3%	0.9 d/month

Table 4: User stickiness

4.3.4 Product categories

In accordance with the findings about popular product categories in section 3.1, the majority of screened tools focuses exclusively on food and cosmetic products and the relevance of problematic substances for health and/or environment. Some tools (e.g. "AbouIt", "Detox Me", "CodeCheck", "ToxFox") cover additional product categories in accordance with the REACH definition of articles but, still, the vast majority of scans relates to personal care products and foodstuffs produced by the popular brands. The data on CodeCheck and ToxFox indicate that after food and cosmetic products, toys are the most popular products to scan, followed by electronics and textiles. To the extent that REACH articles are covered, ToxFox for instance identified 68% of all scanned products as hygiene articles,[76] 12% as toys, and 20% electronics and textiles, furniture, building materials, and sporting goods. This "toxic ignorance" shows the ongoing need for raising awareness about the issue of problematic substances in articles.

4.3.5 Provision of information

Smartphones can be used anywhere, any time. Consumers can access information in the real-life context to facilitate consumption decisions, e.g. at point of sale. Consumers find an app most useful when it gives them precisely the information they need to improve their environmental performance. This implies that receiving information from the app has to be convenient. This section therefore examines the way apps provide product information to users.

After product scanning or search actions, the majority of tools provide product pictures as initial information, confirming that the app has identified the product of interest. Concerning the **detailed product information**, experience shows that a majority of users wants the app only to tell them quickly whether to buy a product or whether better alternatives exist. In contrast, only a small portion is interested in spending extra time on extended content. Consequently, the apps provide information that is easy to understand and allows quick decisions as to the preferable consumption pattern. Notably, tools must be very clear about the hazards or risks a certain product may involve.

The majority of the tools provide **hazard** information related to any problematic substance in a product. In contrast, few apps provide **risk** information, i.e. taking into account the possibility of a problematic substance actually causing harm to human health or the environment, considering the use conditions of a product.

The screened tools mostly apply a numerical and/or colour coded **ranking system** to inform users. In all cases, green implies a safe use of the product or the absence of hazardous substances, and red signifies the presence of a hazardous substance.

[76] This scanning focus can be explained by the evolution of ToxFox, which originally, before adding the REACH right to know function, only applied to cosmetic products, and users are therefore more used to scanning the products in their bathrooms.

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Beyond colour coding, CodeCheck, in particular, provides comprehensive information concerning product safety and product ingredients. After a product has been scanned, the app gives an evaluation in the form of a ring diagram showing the proportions of product ingredients regarded as problematic or as safe. Looking into the background information on evaluation, the user sees a traffic light system for nutritional value (for food) and an evaluation of product ingredients. The latter gives an overview on the amount of problematic or other ingredients within the product. For more detailed information the app provides an evaluation for each ingredient, ranging from harmless (green), slightly alarming (light green) to alarming (orange) or highly alarming (red). Additionally the consumer can access ingredient specific information concerning the utilisation, the manufacturing and any given problematic of the substance.

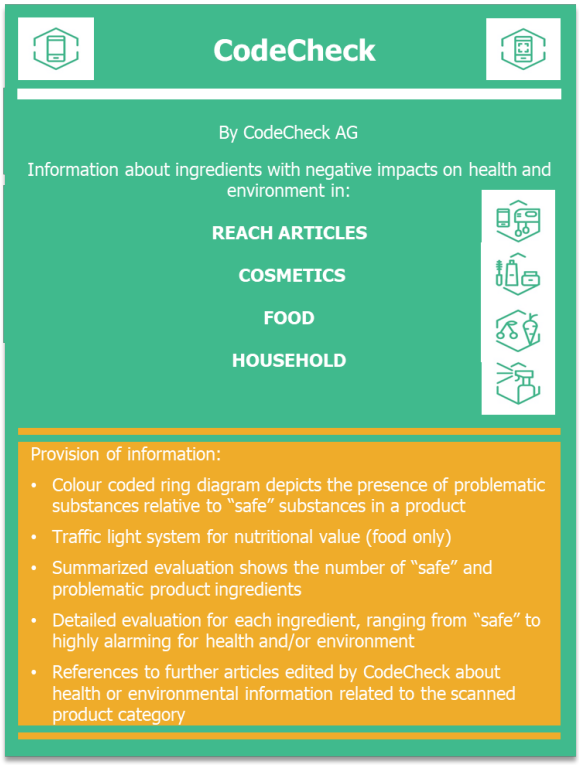

Figure 5: Good practice - CodeCheck (3) (Source: Own figure)

In addition, the app suggests and refers to texts edited by CodeCheck about health, or environmental information related to the scanned product category. CodeCheck uses declaration obligations for food and cosmetic products as a source of information (section 4.3.1) and according to consumer interests and needs, allocates it to topics such as health (endocrine active substances, aluminium, nanomaterials, allergenic fragrances) or environment (silicones, microplastic, palm oil). In addition to "hazardous" properties of ingredients, the app also considers further product impacts relevant for sustainable consumption and production, such as use of palm oil and related risks to biodiversity. When scanning REACH articles, "CodeCheck" usually identifies the article and may provide a picture and feedback from consumers, but it does not provide any edited[77] hazard or risk related SVHC information. Additionally, "CodeCheck" regularly draws the user's attention to product alternatives with lower environmental impacts, e.g. by showing articles made without plastic and/or self-made cosmetic products.

[77] One may find comments added by a user, though.

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The Spanish Abouit app also pursues a strategy of comprehensive information provision. The scan results show a numerical and colour coded ranking system related to the level of concern of a product in terms of health, society and environment. Like the CodeCheck app, Abouit offers a very detailed health evaluation, giving information about the nutritional value of a product as well as about ingredient-specific hazard information. The health evaluation states the presence of a problematic substance and evaluates the risk. Among others, Abouit classifies the ingredients in the categories carcinogens, reproductive toxins, and PBTs.[78]

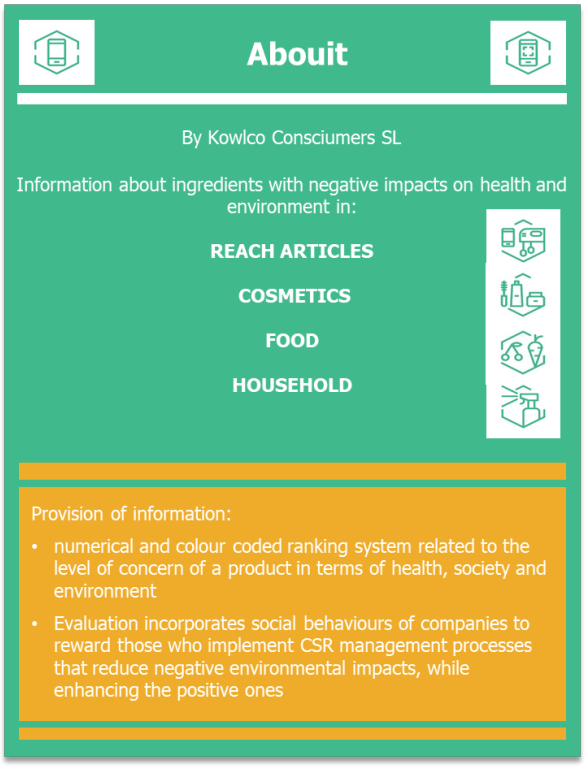

Figure 6: Good practice – Abouit (Source: Own figure)

In contrast, the ToxFox, informs users about the presence of endocrine disrupting chemicals (EDCs) in cosmetic products. After scanning the barcode of a cosmetic product, ToxFox immediately provides information about the presence of a number of substances[79] as well as their function and associated problems. Additionally it visualizes the hazard using a large red exclamation mark. For harmless cosmetic products, the app uses a large green tick.

Both ToxFox and Tjek Kemien provide information about substances of very high concern (SVHCs) in REACH articles. After scanning the barcode of an article, ToxFox shows the product's name and picture. If SVHC information for the requested product is available in the BUND database, the application lists the name of the substance(s) or informs the user that "according to the producer this product does not include any hazardous substances"[80]. If data is not yet available, it informs users that the producer has not yet stored any SVHC information concerning the product, by showing a megaphone highlighted in magenta. It then encourages users to send a request for information according to REACH.[81] Consumers can expect the article supplier's response within 45 days. However, under the current legal situation, article suppliers are not obliged to answer if the product is free from SVHCs. That causes uncertainties for consumers, since no response can mean either that the product does not contain SVHCs or that the supplier did not provide any information and the product could possibly contain SVHCs.

Abouit considers broader environmental and social dimensions within its evaluation. The tool developer evaluates social and environmental performance of companies "based on appraising criteria, rewarding those who have adopted Corporate Social Responsibility (CSR) mangement processes that

78 Abouit 2018a.

79 Those are included on a priority list compiled by the European Commission and indicating research needs, see http://ec.europa.eu/environment/chemicals/endocrine/strategy/substances_en.htm (14.11.2018).

80 Own translation. Original text: „Dieses Produkt enthält laut Hersteller keine gefährlichen Schadstoffe."

81 As explained in section 2.1.

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reduce negative environmental impacts wherever they operate, while enhancing the positive ones."[82] Abouit seeks to comment on a company's performance in terms of social responsibility and to this end evaluates information from the companies themselves about corporate social responsibility (e.g. CSR reports or questionnaires sent by Abouit) or from third parties (supervisory boards, trade unions, and NGOs). The social and environmental evaluation process is carried out by Abouit's partner "Economistas sin fronteras"[83]

4.4 Impact on consumer behaviour

Measuring an app's effects on consumer behaviour is a demanding task. Based on discussions with industry and retailers as well as an evaluation of the apps' coverage in media reports, some developers assume that, at least, they raise awareness among consumers (see also tool use, section 4.3.3) and market actors.

For some tools, more detailed impact data is available. An online survey of nearly 5,800 "ToxFox" users (for cosmetics) found that some 72 % had checked all or almost all the cosmetic products they use regularly for endocrine disruptors. In contrast, only 31 % of some 390 non-users also surveyed have made the same checks. Accordingly, 61 % of the "ToxFox" users say it is very easy for them to determine whether a product contains EDCs, while 61 % of the non-user respondents reported that it was not easy.[84] From this, one can conclude that the "ToxFox" significantly reduces the consumers' transaction costs for gathering information.[85] At the same time, 91 % of "ToxFox" users said that they purchase no or nearly no cosmetic products which they know to contain EDCs (N=5492).

As for ToxFox (SVHCs) the same principles should apply.

Kemiluppen receives external feedback from consumers (via email), saying the app makes it easier to choose the 'better' products and that they had stopped using certain products. The US tool "GoodGuide" also claims to have effects on purchasing decisions. As part of the product evaluation, the tool offers direct links to stores where consumers can buy products. The developers noticed that higher rated products have more click-throughs to purchases from e-commerce sites; especially products that are higher rated than the product a user initially considered.

82 Abouit 2018b.

83 Economistas sin fronteras is a Spanish NGO which combines people interested in building a fair, supportive and sustainable economy, with a primary orientation towards the eradication of poverty and inequalities. Their main objective is to achieve fair economic and social structures, based on human rights, cf. https://ecosfron.org/quienes-somos/.

84 Brenig 2017.

85 Brenig (submitted).

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Figure 7: Good practice – GoodGuide (Source: Own figure)

GoodGuide also claims that dedicated users make their choices based on the app's product rating. In the case of negative product ratings, GoodGuide observes brand switching away from low-rated products.

Looking at the reviews users leave about the tools in app stores, many find the screened tools helpful. Moreover, user reviews of the analysed applications published within the app stores confirm the tools' potential to stimulate pro-environmental behaviour. CodeCheck, in particular, receives high scores. Many users write about how, due to the app, for the first time they became aware of the multiplicity of ingredients and substances present in daily products. After looking at the product evaluation, users claim to be concerned. Others feel encouraged by the app to begin avoiding these products and living a healthier lifestyle. Many consumers confirm a change in their personal purchasing behaviour after having found out about problematic substances in products. In this context, they appreciate search functions for alternative products. User criticism mostly addresses the tools' technical implementation, such as problems with the scanning function, slow processing of requests, or a lack of memory functions.

4.5 Impact on company decision-making

Apps can raise companies' awareness on the issue of problematic substances in their products. Notably, they show that consumers reject such products. From this perspective, impact starts when companies learn that consumers are using such a tool, and that products which include problematic substances have low ratings in the app. In fact, already the mere availability of an app can influence company decisions in the process of product design or in the placement of orders - even if only a small number of consumers is actually using a tool to scan their products. Companies receive the strongest impulses, though, from tools facilitating direct communication between consumer and business, such as ToxFox and Tjek Kemien. For instance, between July 2013 and October 2016, ToxFox users sent about 143 000 protest-emails from iOS-devices, whereas some companies have received considerable numbers of protest-emails (e.g. Beiersdorf has received 28 627 protest-emails, or 24 per day on average).[86] A company ignoring this consumer feedback would risk losing business. According to the developers of "GoodGuide", apps help to shape suppliers' and producers' awareness of the commercial risks posed by products containing ingredients that result in low ratings. Brands that recognize market opportunities here will seek ways to improve their ratings in the app. In fact, the developers are of the impression that companies and industries are rather supportive regarding the apps. One can only assume that companies take into account direct consumer feedback, scanning

86 Brockmann and Brenig (manuscript).

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actions, and product ratings in their product policies. With this in mind, all surveyed tool developers state that the tools have had some impact on company decision-making.

Cooperation between tool developers and their (target) companies is an early indicator of impact because it shows that companies recognize the tool's relevance. Except for one of the analysed tools, all apps offer opportunities for cooperation with companies. With some tools, such cooperation is already widely established, with companies providing ingredient data or further product related data to the databases. Especially "green" brands aim to improve their ratings and profile in the tools. Besides, developers of some tools work closely together with stakeholder groups such as businesses, industry, and NGOs, including meetings on a regular basis.

Some tools designed forms of cooperation going beyond data provision. GoodGuide, under the headline "Partnering with GoodGuide", lists a partnership programme and its benefits. Brands can become advertising partners and place personalised stories about their products on the app, while the commercial tool generates advertising revenue and the benefits of accurate product information. Another way GoodGuide can interact with companies is through the parent company's (UL) WERCSmart platform (section 4.2.1).[87] In addition, companies that contribute additional data about the concentration of chemicals in their products can qualify for a "benchmark exception" and get an improved score if concentrations are below safety benchmarks. Like GoodGuide, CodeCheck encourages companies to get in direct contact with them and become advertising partners. Companies/brands can increase their brand awareness and sales, since CodeCheck offers product related links to the brands' online stores.[88] As additional incentive, CodeCheck incorporates voluntary questionnaires, relevant for product design in the app. The data is forwarded to producers.

According to other developers, incentives for companies to collaborate with an app include the opportunity to update and ensure correct data as well as to find out about their consumers' concerns and complaints. The latter is valuable information, as companies usually want to promote customer loyalty – because acquiring new customers is very costly, especially in competitive markets. Finding out about customer dissatisfaction is very complex and expensive. Apps can help to simplify this process and reduce costs. In this respect, tools are most relevant if they go beyond passive scanning and allow users to actively get in contact with companies. Among the analysed apps, ToxFox (for cosmetics) offers customers the opportunity to send protest-emails to

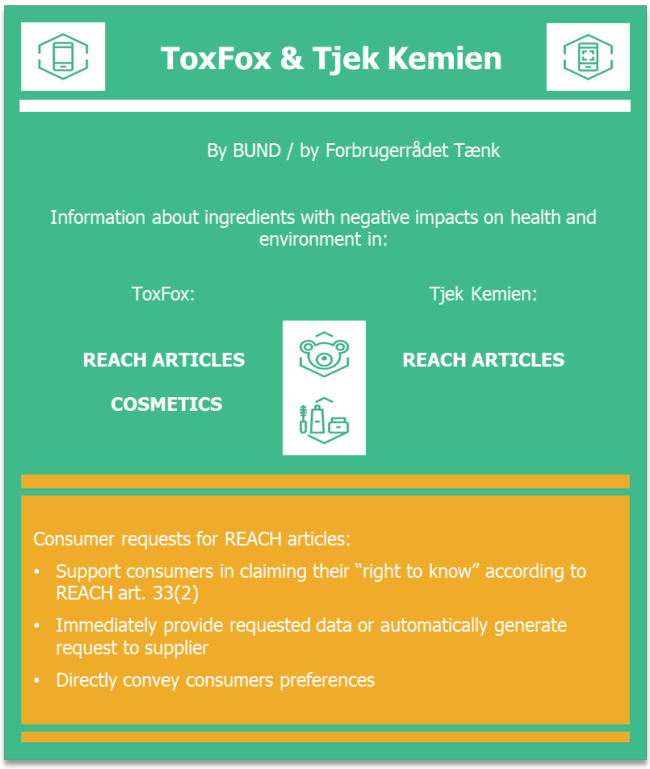

Figure 8: Good practice - ToxFox and Tjek Kemien (Source: Own figure)

87 GoodGuide Inc. 2018.
88 CodeCheck AG 2018b and CodeCheck AG 2018d.

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companies (regarding EDCs in cosmetics). In addition, two tools forward consumer requests to article suppliers and thereby emphasize customer preferences. The ToxFox (for REACH articles) and Tjek Kemien both support consumers in claiming their right to know according to REACH Article 33(2). When a consumer scans an article (toys, textiles, furniture, electronics, etc.) for which information is not yet available in the tool's database, the user can send a request for SVHC information and the app forwards the request to the supplier. If the article contains SVHCs, the supplier is obliged to respond within 45 days. Afterwards, the apps populate the supplier information into the databases, so that future requests can access this data. The database development is an elaborate process because article suppliers often fail to respond with information.[89]

Obtaining data about the extent to which apps contribute to safer product redesign is a huge challenge, not least because companies are reluctant to admit the role of apps in this context. They tend to emphasize that such design changes were solely their idea. Going back to the ToxFox example (for cosmetics), protest-emails could help businesses understand consumer dissatisfaction and thereby encourage behavioural change by applying the information to innovations such as the substitution of endocrine disrupters. In fact, a study on the tool concludes that in combination, the results of the in-depth interviews [with manufacturers and associations] and answers to the protest-emails and individual customer enquiries suggest that the ToxFox had an impact on cosmetic firms' decision to substitute. In particular, five interviewees agreed that the ToxFox increases the public awareness and pressure regarding endocrine disruptors in cosmetic products. At the same time, one interviewee stated the obvious and named public pressure as the main reason for this particular company's substance substitutions.[90] Apps contribute to public pressure and to that extent have at least an indirect impact on company decision-making.[91]

In addition, some developers could report on specific success stories in terms of direct links between a tool and company decision-making. The ToxFox (for REACH articles) demonstrated its impact e.g. after the French sporting goods retailer Decathlon removed a product from stock in Germany due to a REACH request via the app. The product contained the plasticizer DEHP at a concentration of 0.1 per cent of the product weight. DEHP can interfere with the human hormone balance and is harmful for the environment. Genevieve Mulack, spokesperson for Decathlon, answered the ToxFox user request as follows: *"Following your request and the subsequent test result, we decided to immediately remove the product from stock in Germany [...]".*[92]

89 Cf. section 2.1.

90 Brockmann and Brenig (manuscript).

91 CodeCheck reports about indirect impact on a legislation amendment, after publishing a comprehensive microplastic study in cooperation with BUND. The study aroused media interest and eventually was used by the German Green Party to stimulate a legislation amendment in the German Bundestag.

92 BUND 2018.

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5 Conclusions

This report aims at providing an overview of existing consumer apps regarding chemical substances in products and their performance in terms of changing consumer behaviour and incentivising changes in product design by suppliers. The screening of consumer tools in 13 EU Member States taking part in the LIFE AskREACH project identified 32 relevant EU-based apps, as well as 4 third-country apps. The majority of these tools focus on providing general and product related information about chemicals and their (potential) impacts on human health. Some, in addition, give general and product specific information about (potential) environmental impacts. A few tools compare product prices and give general information on product ingredients, nutritional values, recipes, shopping lists etc.

The main conclusions from the analysis of eight selected consumer apps are as follows:

- Data sources and reliability: The usual way to obtain master data is via databases. Most of the content is monitored and kept up-to-date by the tool developer and/or by the database owner. In addition, tools apply different approaches to involving product suppliers and tool users. Suppliers are usually entitled to provide and adjust data about their products. This first-hand information contributes to data reliability. In addition, some tools establish consumer feedback channels. As regards overall credibility of an app, consumers have confidence in information provided by reputable sources. However, suppliers are not regarded as an overly credible source.
- Consumer campaigns can influence consumer motivation with respect to health or environment related issues. They can be applied as a manifestation of the app's goals in the users' local context and they can contribute to keeping the app users engaged. Marketing via social media has proven efficient and social media presence is a prerequisite. However, newspapers and television (still) ensure the greatest outreach. Linking tool-related messages to health issues is an effective way to create consumer awareness. Showing how the app's goals and user actions contribute to the "bigger picture", for example sustainable development, is another useful communication strategy. This is backed by Eurobarometer findings, according to which 90% of EU-28 citizens are worried about the impact that chemicals in products can have on the environment – thus exceeding concerns these citizens have regarding their own health (84%). Advertisements and marketing activities have to show up periodically in order to sustain user initiative and enthusiasm. Key target audiences are consumers most interested in a product's potential health impacts (i.e. parents, especially [expectant] mothers, and people living a lifestyle of health and sustainability [LOHAS]), as well as "activists", who can be expected to make many scans.
- Sustained user involvement is pivotal because behavioural change involves breaking existing habits or creating new ones, which is a long-term process. In this respect, ensuring the continued use of a tool once it has been downloaded is challenging. In times of information overload, with a plethora of smartphone apps, the product information provided by such an app may motivate users to "try" it several times. However, when it comes to keeping users engaged over a longer period, analysis shows that tool features are helpful which appeal to the play instincts of the *homo ludens*. Such "gamification" features include reward systems as well as elements of social competition within peer groups, both implying the need for more personalised tool settings. In addition, consumer campaigns can contribute to sustained involvement.
- Most of the screened tools already reflect which product categories are at the focus of consumer interest, i.e. the two broad areas of food and cosmetics. Toys are the third most popular articles that consumers scan.

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- Tools must provide information, which is relevant for the consumer, e.g. addressing motivational aspects such as perceived risks. In addition, processing the app and retrieving information has to be convenient. Experience shows that most users want the app to tell them quickly whether to buy a product or to inform about better alternatives. In contrast, only a small proportion are interested in spending extra time on more detailed contents. Consequently, apps have to provide information that is easy to understand and allows quick conclusions to be made. At the same time, information must be very clear about hazards or risks for a product. Displaying health and environmental impact information in a colour-coded system is an established practice (e.g. green and red signs for products). This is a common way to provide information relevant for different consumption contexts at one glimpse, while at the same more detailed background information on the product evaluation is often only a click away. In addition, some tools also aim to be a "lifestyle adviser", offering contents that goes beyond product information.
- Consumer impact: Especially tools applying gamification features have a higher likelihood of sustained consumer use, i.e. checking the tool in the context of everyday consumption decisions becomes a habit. Direct impact of a tool is interrelated with the product range it covers and consumer risk perception in this respect. For example, a survey of users of a cosmetics tool shows that it significantly facilitates identification of problematic substances in cosmetics, so that users do not purchase such products. Besides, there are indications that where tools provide information on alternative products with better performance in terms of health/environment, users tend to prefer these.
- Company impact: Apps can raise companies' awareness on the issue of problematic substances in their products. Notably, they show companies that consumers reject such products. From a product design perspective, impact begins already well before consumers use the app. The mere fact that (well-structured and popular) apps are available can influence company decisions in the process of product design or in the placement of orders. Besides, apps contribute to public pressure and to that extent at least have an indirect impact on company decision-making. For ToxFox, a success story in terms of a direct link between tool and company decision-making is reported.
- Apps also yield benefits for companies who can find out about customer concerns and dissatisfaction. Some tools establish a communication channel for companies, giving them the opportunity to get in contact with their customers, for instance by writing about the products origin and "personalizing" the product.

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7 Appendix

7.1 Tool questionnaire

(Template for the project partners)

Name of the tool:

Internet source(s):		*Your answers*
Design		
Is it an app or a website (enhanced for mobile phones?)	Please describe	
What languages does the tool support?	Please describe	
Who is the developer of the tool?	Product supplier	
	Authority (which?)	
	NGO (which?)	
	Other, please describe:	
Who provides product data used by the tool?	Users	
	Product suppliers	
	Tool developer	
	Other, please describe:	
Do you have to pay for the app to unlock certain functions?	Please describe	
Is the app available for iOs?	Yes/No	
Is the app available for Android?	Yes/No	
Is the app available for Windows?	Yes/No	
What data (name, e-mail-address etc.) has to be provided by user?	Please describe	
Functions		
Can products be scanned?	You scan barcode	
	You take a picture of ingredient lists	
	Other, please describe:	
Is there a search function (using the app to browse for products)?	Yes/No	
	Please describe	
Is there information/advertisements on alternative products (which do not contain unwanted chemicals etc.)?	Yes/No	
	Please describe	

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Are there direct internet links to purchase a product?	Yes/No	
Are there other relevant features?	If yes, please describe	
Can users comment/provide feedback on products/share results (visible also for other users)	Yes/No	
	Please describe	
Scope		
Which product categories are covered?	All REACH articles	
	Certain REACH articles, namely:	
	Food	
	Cosmetics	
	Biocidal products/ plant protection products	
	Household chemicals / detergents	
	Other, please describe	
Are there product pictures?	Yes/No	
	Please describe	
What hazard/risk information is provided?	General information on human health hazard (please describe)	
	General information on environmental health hazard (please describe)	
	General information on hh risk (or exposure) (please describe)	
	General information on env risk (or exposure) (please describe)	
	Product specific information on hh hazard	
	Product specific information on env hazard	

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	Product specific information on hh risk (or exposure)	
	Product specific information on env risk (or exposure)	
	Advice on safe use and disposal conditions / behaviour	
	Other, please describe	
Are there specific means to communicate results?	Numerical ranking system related to the level of concern related to a product	
	Colour coded ranking system related to the level of concern related to a product	
	Other, please describe	
Are specific consumers addressed by the tool?	Parents	
	Workers	
	Allergy sufferers	
	Other, please describe	
Framework conditions		
Are there legal labelling obligations for products which fall under the tools scope?	Yes/No	
	Please describe	
Are there legal authorisation or related requirements for products which fall under the tools scope?	Yes/No	
	Please describe	
Any other relevant aspects?	Please describe	
Ad hoc impact assessment		
What is the (claimed) number of downloads (e.g. according to app store or statements by developers)?	<1,000	
	<25,000	
	<100,000	
	<1 m	
	>1 m	
	Please describe	
What is the (claimed) number of active users (e.g. according to statements by developers?	<1,000	
	<25,000	
	<100,000	
	<1 m	

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	>1 m	
	Please describe	
If available: What is consumer feedback on the tool?	Please describe	
If available: What are reactions by industry? (e.g. product manufacturer or industry association press release)	Please describe	
Is third party information on the impact of the tool on consumer or market actor behaviour already available (e.g. provided by developer, research papers) ?	Yes/No	
	Please describe	

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7.2 Survey: Data sources

(Template for tool developers)

Criteria	Questions	Your answer
Article information (master data) and pictures	- If the Tool provides master data and product pictures: Which source are they coming from?	-
Apps working in multiple countries: We noticed that Detox Me offers a Spanishversion. Does that mean that Detox Me can also provide information on Spanish and South American products?	- How does the sourcing process work for tools used in more than one country?	-
Translation process for multi-language apps	- How does it technically work when offering one app in several countries?	-
What are the data sources?	- From which databases do you obtain product related information?	-
Information quality	- How do you ensure data reliability (Quality control)?	-
	- Who keeps track of changes? Tool developer? Owner of database?	-
	- How do you manage liability for possibly incorrect data	-

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7.3 Survey: Consumer tools

(Template for tool developers)

Part I: Consumer Campaigning

Guiding questions			Please comment
What are your target groups		Parents	
		Environmentalist	
		Schoolteacher	
		Public procurement	
		Trade unions, Workers	
		Midwives	
		Teenagers	
		Activists	
		Healthy living / Sporty	
		LOHAS	
		Pet lovers	
		Others	
How do you approach your target groups	Which channels do you use for advertisement?	Social media	
		Push messages (via app)	
		Newspaper	
		Professional journals	
		Newsletter/magazine for members of your organization	
		Blogs, influencers etc.	
		Television	
		Radio	
		Events	
		Others (please describe	
	How often do you advertise your app?	e.g. intervals	
Do you have any best practices regarding the approach of a particular target group?			
Do you have any lessons learned regarding the approach of a particular target group?			

Any other relevant information:

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Part II: Use of tools

Guiding questions		Please comment
What is the number of individual requests?	e.g. per day, month or year	
	in total	
What is the total numberof installations?		
What is the amount of active users?	Daily active user (DAU)	
	Weekly active user (WAU)	
	Monthly active user (MAU)	

Any other relevant information:

Part III: Impact on consumer consumption behaviour

Guiding questions		Please comment:
Does the tool contribute to changes in consumption behaviour, i.e. product buying and use patterns in particular?		
In how far do consumers trust and rely on the tool?	Do consumers buy/use products that got "bad marks" by the tool?	
If a scanned product receives a "bad mark" by your app, what role does the availability of alternative products play for your consumers' purchasing decision?	How do consumers weight information such as "bad mark", availability of alternatives, prices etc., in their purchasing decisions?	

Any other relevant information:

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Part IV: Product categories

Guiding questions		Please comment:
Which companies/Categories/products are at the centre of consumer requests	Top 10 most scanned companies	
	Top 10 most scanned categories	
	Top 10 most scanned products	
Why these companies/categories/products?	e.g. Company/products were conspicuous because of product scandals	
	e.g. Consumers are more aware of risks/hazards regarding the products addressed by our tool	
	e.g. Consumers are not at all aware of risks/hazards regarding the products addressed by our tool ("toxic ignorance")	

Any other relevant information:

Part V: Risk/Hazard

Guiding questions		Please comment:
Which hazards or risks do you communicate to consumers? Definition: Hazard: Means in this context the presence of a hazardous substance such as BPA Risk: Means the possibility of causing harm to human health or the environment, taking into account the actual use conditions of a product containing e.g. BPA.		
How do you explain your risks/hazards in an easy way?	(e.g. text, symbols, audio-clip, video)	
When providing articles within the meaning of REACH Regulation*, what are consumer attitudes/risk perceptions regarding chemicals in the respective product?		

*REACH articles include textiles, electronics, toys, furniture

Any other relevant information:

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Part VI: User Engagement

Guiding questions		Please comment:
Personalization features	Can users adapt the tool to personal lifestyle?	
	What personalization options does the tool offer?	
Gamification features	Quick tutorial in app for new scanners (showing what happens when you scan a product)	
	Instant feedback when scanning a product (could be visualized as a "Good job!" thumbs up, or a confetti rain for every 10th scan. Can also be a mark/badge?)	
	Brag button, to share your scans and scan results with friends and family, social learning function to compare behaviour with friends and family	
	Sudden reward (pop-ups as "Nice scan!" "You are a winner", "Wow, you scanned a lot of toys!)	
	Colour level /badges per number of scans (Bronze level once you scan more than 10 products, silver when you reach 50, and gold above 100)	
	Reminder function (remind users to perform environmentally friendly)	

Any other relevant information:

Part VII: Impact on company decision-making

Guiding questions		Please comment
Does the tool have an effect on company decision-making as regards chemicals in products?		
Has there been a company campaign?		
What did the company campaign look like		
Do companies/ industry sectors pursue specific strategies as to the tool? (supportive/opposed)		
Are you aware of concrete product changes that can be traced back to the tools influence?		
Does the tool offer opportunities for cooperation with companies?	(e.g. to maintain data)	
	What is the incentive for companies?	

Any other relevant information:

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7.4 Short descriptions of tools

(Tools, considered relevant by the project partners)

Origin	Germany				Netherlands
Name	ToxFox	BarCoo	Scan4Chem	Giftfrei einkaufen	Questionmark
Tool developer	BUND	Offerista Group GmbH	German Environment Agency (UBA)	WECF Germany	Questionmark Foundation
Product categories	REACH Articles (Toys), Cosmetics	REACH articles (electronic devices, children toys, furniture, textiles), Cosmetics, Food, Household chemicals detergents	REACH articles	REACH articles (Textiles, clothing, toys, construction material, furniture), Cosmetics, Household chemicals/detergents	Food
Purpose	General and product-specific product information about ingredients with negative impacts on health and environment. Information about the presence of SVHC in articles.	Main purpose: The comparison of product prices. Secondly: Nutritional lights for food products and basic approaches for a sustainability lights evaluation	Sends REACH consumer requests to manufacturers/suppliers	General product information about ingredients with negative impacts on health and environment. Information about the presence of SVHC in articles.	General and product-specific product information about ingredients with negative impacts on health and environment.
Features	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: Yes	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: N/A
Language options	German	German, French, Italian	German, English	German	English, Dutch
Customer ranking (Google play store 09/19/2018)	4.0 of 5 (2,011 reviews)	4.3 of 5 (49,758 reviews)	4.2 of 5 (21 reviews)	N/A	3.5 of 5 (185 reviews)
Website	https://www.bund.net/chemie/toxfox/	http://www.barcoo.com/	https://www.umweltbundesamt.de/tags/scan4chem	http://nestbau.info/app-download/	http://www.thequestionmark.org/en/method/

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Origin	Switzerland	Denmark			Serbia
Name	CodeCheck	Kemiluppen	Kemilex	Tjek Kemien	Bebac
Tool developer	CodeCheck AG	Danish Consumer Council THINK Chemicals	Astma-Allergi Denmark	Danish Consumer Council	Medium Group
Product categories	REACH articles, Food, Cosmetics, Household chemicals/detergents	Cosmetics	REACH articles (Sheets, pillows, daipers, paint, detergents, dishwashing products, sanitary napkins/pads), Cosmetics, Household chemicals/detergents	REACH articles, cosmetics	REACH articles (Children toys and product, child care products), Cosmetics
Purpose	General and product-specific product information about ingredients with negative impacts on health and environment.	General product information about ingredients with negative impacts on health and environment.	General and product-specific product information about allergenic ingredients.	General and product-specific product information about ingredients with negative impacts on health and environment. Information about the presence of SVHC in articles.	General product information about ingredients with negative impacts on health.
Features	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: Yes	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: No	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: Yes	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: yes Recommendation of alternative products: no Profile personalization: No
Language options	German, English	Danish	Danish, German, English, Japanese, Russian, Spanish, Trad. Chinese, Simpl. Chinese	Danish	Serbian
Customer ranking (Google play store 09/19/2018)	4.6 of 5 (31,002 reviews)	4.0 of 5 (271 reviews)	3.1 of 5 (35 reviews)	2.9 of 5 (132 reviews)	4.8 of 5 (8,346 reviews)
Website	https://www.codecheck.info/	https://play.google.com/store/apps/details?id=dk.fbr.kemiluppen	https://play.google.com/store/apps/details?id=dk.kemilex	https://tjekkemien.dk/	www.bebac.com

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Origin	Czech		Spain		Poland
Name	Fer Potravina	Bez Andreje Bez Babiše	Abouit	Ingred	Wiesz co jesz
Tool developer	http://www.ferpotravina.cz/o-nas	Martin Vytrhlík	Kowlco Consciumers SL	Mr. Raúl Vadillo	ADF Apps
Product categories	Food	unclear	REACH articles (home appliances, electronics, (paper products) care (diapers and wipes)), Food, Cosmetics, household chemicals/detergents	Food, Cosmetics	Food
Purpose	General and product-specific product information about ingredients with negative impacts on health.	Identifies products made by the entrepreneur "Andrej Babiš".	Product-specific information about ingredients with negative impacts on health. General product information about ingredients with negative impacts on environment (approaches for social evaluation of product manufacturer).	General and product-specific product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health.
Features	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: Yes	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: Yes
Language options	Czech	Czech	Spanish	English, Basque, Catalan, French, Galician, German, Greek, Italian, Portuguese, Spanish	Polish
Customer ranking (Google play store 09/19/2018)	3.8 of 5 (1,417 reviews)	4.2 of 5 (364 reviews)	4.1 of 5 (122 reviews)	4.4 of 5 (801 reviews)	4.2 of 5 (2.139 reviews)
Website	https://www.ferpotravina.cz/ecka	https://play.google.com/store/apps/details?id=com.vytick.bezandreje&hl=cs	http://www.abouit.eu/home	https://itunes.apple.com/be/app/ingred/id1171075587?mt=8	http://www.eat-what.info/

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Origin	Poland				
Name	Czytamy etykiety	Zdrowe zakupy	Chemia w żywności	eFood	Cosmetic scan
Tool developer	Jestem Eko	Wojciech Jaworski	Grzegorz Jamiołkowski	Establishment Sp. z o.o.	Cosmetic Scan
Product categories	Food, Cosmetics	Food	Food	Food	Cosmetics
Purpose	General and product-specific product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health.
Features	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: No	Product pictures: No Recommendation of alternative products: Yes Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No
Language options	Polish	Polish, English	Polish	Polish	Polish
Customer ranking (Google play store 09/19/2018)	3.5 of 5 (119 reviews)	3.8 of 5 (25 reviews)	4.0 of 5 (46 reviews)	N/A	N/A
Website	http://czytamyetykiety.pl/aplikacja/	http://zdrowezakupy.org/	goo.gl/nGUR2, goo.gl/h4iB8v	https://play.google.com/store/apps/details?id=pl.moveapp.efood&hl=pl	www.cosmeticscan.tech

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Origin	Poland			Greece	
Name	Pola	Perfect Beauty	Open Beauty Facts	nutrInsider-the all in one supermarket app	Ingredio
Tool developer	Klub Jagielloński	Skye Software Apps	Interesting Views	SAINTIAGO	DENTICA LLC
Product categories	REACH articles, Food, Cosmetics	Cosmetics	Cosmetics	Food	Food, Cosmetics
Purpose	Shows the country of origin of the product (whether the company produces in Poland, whether it carries out research and development in Poland, whether it is registered in Poland, where it has production facilities)	General and product-specific product information about ingredients with negative impacts on health.	Unclear purpose - Application does not inform about dangerous ingredients in the product	General information on product ingredients, nutritional value (carbs, proteins, fat, calories), recipes, prices, shopping lists	General product information about ingredients with negative impacts on health.
Features	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No
Language options	Polish	Polish	Polish, English	English, Greek	English, French
Customer ranking (Google play store 09/19/2018)	4.8 of 5 (7,287 reviews)	3.6 of 5 (56 reviews)	N/A	3.8 of 5 (168 reviews)	4.0 of 5 (142 reviews)
Website	https://www.pola-app.pl/	http://perfectbeauty.mobi/aplikacja	https://world.openbeautyfacts.org/	http://www.nutrinsider.gr/english	http://www.ingred.io/

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Origin	Sweden				Luxembourg
Name	Vara utan fara (website only)	Food additives	Konsumentguiden Äkta Vara (website only)	Eco Archive / Eco Online	WikiFood (Website only)
Tool developer	Stockholm University and KTH (Royal Institute of Technology)	e-verbum	Äkta Vara	EcoOnline AS	Luxembourg Institute of Science and Technology
Product categories	REACH articles (Childcare products, construction products, Toys, electric equipment, Clothes and accessories)	Food	Food	Industry chemicals	Food
Purpose	General and product-specific product information about ingredients with negative impacts on health and environment.	General product information about ingredients with negative impacts on health.	General product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health and environment.	General and product-specific product information about ingredients with negative impacts on health.
Features	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: Yes	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No
Language options	Swedish	English	Swedish	Norwegian, Swedish, Danish, English, Finnish, German, Dutch, French, Italian, Spanish, Lithuanian, Latvian, Portuguese, Polish, Estonian, Slovak, Czech, Slovenian, Icelandic, Bulgarian, Romanian, Hungarian, Greek, Russian	German. English, French
Customer ranking **(Google play store 09/19/2018)**	N/A	4.4 of 5 (544 reviews)	N/A	2.8 of 5 (3 reviews)	N/A
Website	http://varautanfara.se	https://play.google.com/store/apps/details?id=com.everbum.eia&hl=en	https://konsumentguiden.aktavara.org	https://ecoonline.se	www.wikifood.eu

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Origin	Finland	Korea	USA		
Name	CosmEthics	Danger Map	Healthy Living USA	Detox Me	GoodGuide
Tool developer	CosmEthics Office	Ministry of Labor and Health and No Cancer NGO	Environmental Working Group (EWG)	Silent Spring Institute	GoodGuide
Product categories	Cosmetics	REACH articles (Toys, furniture, shoes, pencils, household products), Cosmetics, Household chemicals/detergents	Food, Cosmetics	REACH articles (furniture, home building products, textiles, children products), Food, Cosmetics, Household chemicals/detergents	Food, Cosmetics, Household chemicals/detergents
Purpose	General product information about ingredients with negative impacts on health.	General product information about ingredients with negative impacts on health and environment.	Product specific information about ingredients with negative impacts on health.	General product information about ingredients with negative impacts on health.	General and product-specific product information about ingredients with negative impacts on health.
Features	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: Yes	Product pictures: Yes Recommendation of alternative products: No Profile personalization: No	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: No	Product pictures: No Recommendation of alternative products: No Profile personalization: Yes	Product pictures: Yes Recommendation of alternative products: Yes Profile personalization: Yes
Language options	German, English, Finnish, French, Portuguese, Swedish, Simplified Chinese	Korean	English	English, Spanish	English, Simplified Chinese, Traditional Chinese
Customer ranking (Google play store 09/19/2018)	3.6 of 5 (367 reviews)	N/A	3.6 of 5 (3,026 reviews)	4.2 of 5 (62 reviews)	2.1 of 5 (36 reviews)
Website	http://www.cosmethics.com/	N/A	https://www.ewg.org/	https://silentspring.org/detoxme/	https://www.goodguide.com/about/data

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