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BAN BISPHENOLS IN ALL PRODUCTS

Policy briefing paper

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ARNIKA
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This paper results from the ToxFree LIFE for All[1] project, which raises awareness by telling stories and presenting accurate laboratory measurements about products and the harmful substances they may contain. ToxFree LIFE for All also supports policy changes for restricting and phasing out chemicals of concern, thus protecting people and the planet.

Coordinating Beneficiary: Tudatos Vásárlók Egyesülete (Association of Conscious Consumers) (HU); associated Beneficiaries: Arnika (CZ), dTest (CZ), Zveza Potrosnikov Slovenije Drustvo (SI), Verein Für Konsumenteninformation (AT).

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Arnika is a Czech non-governmental organization established in 2001. Its mission is to promote environmental health, raise awareness and work toward toxic pollution reduction within the European and global context. Arnika's Toxics and Waste Programme aims to eliminate the use and releases of POPs and other toxic chemicals in the Czech Republic as well as globally. Our work is based on research, developing evidence-based inputs for use in policy dialogues and running public awareness raising campaigns for a variety of stakeholders including the general public, NGOs, media, public servants and businesses. Our science-based studies promote measures to ensure that the EU legislation becomes a flagship of a sustainable and just environmental legal framework. **www.arnika.org/en**

dTest is the largest Czech consumer organisation and has been operating in the Czech Republic since 1992. Our mission is to provide comprehensive services to consumers. We publish the dTest magazine, which publishes the results of independent and objective product tests, information on consumer rights and advice on how to exercise these rights effectively. Our comparators and calculators make it easy to choose services. Through our constantly updated database we also warn about dangerous products, deceptive business practices and educate businesses and consumers. We provide free consumer advice to consumers. dTest is part of the International Consumer Research and Testing Organisation (ICRT) and the European consumer organisation BEUC. **www.dtest.cz**

1 *https://tudatosvasarlo.hu/toxfree-life-for-all-english*

VKI, the Austrian Consumer association, was founded in 1961 as a testing organisation. Main fields of VKI´s activities comprise product testing, publishing, law enforcement and advice to consumers. VKI is located in Vienna and runs advice centers in Vienna and Innsbruck. Content-wise VKI has special expertise on topics like health and safety of products and food, sustainability and environment, financial services and consumer law. **www.vki.at**

TVE (Tudatos Vásárlók Egyesülete - in Hungarian, or the Association of Conscious Consumers (ACC) - in English) has been promoting sustainable, circular, ethical, fair and just consumption and lifestyle choices since 2001. Its main goal is to make consumers aware of the environmental, social, and ethical aspects of their consumption and to help them to live more sustainable lifestyles while making ethical choices. ACC works mainly, but not exclusively, in the following fields: food consumption, local and global supply chains, household chemicals, advertising, consumer rights, product and service testing. It delivers campaigns, educates and builds communities, conducts background research, and lobbies decision makers to achieve this aim. **www.tudatosvasarlo.hu**

ZPS, the Consumers´ Association of Slovenia, is a non-profit independent non-government membership consumer organisation established in 1990 to defend, promote and advocate for the interests of consumers. We work for consumer-friendly legislation, promote good consumer choices, test products, try and evaluate services, provide advice and help in cases of consumer confusion. Currently, it has approximately 7,000 active (membership fee paying) members. More than 90% of Slovenians are aware of ZPS and the association is respected by the general public as well as businesses. Its web portal **www.zps.si** is the country's most important national web portal for consumer information and advice and has approx. 500,000 unique visitors per year. ZPS acts as the champion of individual consumers, through advice and information, research and advocacy, campaigning and policy-making and represents Slovenian consumers nationally and internationally.

ARNIKA

Test

VKI: VEREIN FÜR KONSUMENT INFORMATIO

TUDATOS VÁSÁRLÓK EGYESÜLETE

ZPS ZVEZA POTROŠNIKOV SLOVENIJE

LIST OF ABBREVIATIONS

AFIRM – Apparel and Footwear International RSL Management

BADGE – Bisphenol A Diglycidyl Ether

BPA – Bisphenol A

BPAF – Bisphenol AF

BPAP – Bisphenol AP

BPF – Bisphenol F

BPS – Bisphenol S

CLP – Classification, Labelling and Packaging Regulation

ECHA – European Chemicals Agency

EDC – Endocrine Disrupting Chemical

EFSA – European Food Safety Authority

ESPR – Ecodesign for Sustainable Products Regulation

GOTS – Global Organic Textile Standard

LC-MS/MS – Liquid Chromatography–Mass Spectrometry/Mass Spectrometry

OEKO-TEX – International Association for Research and Testing in the Field of Textile and Leather Ecology

PC – Product Class (as used in OEKO-TEX standards)

REACH – Registration, Evaluation, Authorisation, and Restriction of Chemicals

SCCS – Scientific Committee on Consumer Safety

SML - Specific Migration Limit

SVHC – Substance of Very High Concern

TDI – Tolerable Daily Intake

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EXECUTIVE SUMMARY

This policy paper explores bisphenols' environmental and health risks, explicitly focusing on their use in textiles. Various bisphenols are identified as endocrine-disrupting chemicals (EDCs) with significant implications for human health, including reproductive and developmental disorders. This paper presents detailed findings from a comprehensive survey of bisphenol content in underwear textiles.

The laboratory test initiated by consumer associations from Hungary (TVE), Austria (VKI), Slovenia (ZPS), and Czechia and Slovakia (dTest), as well as Arnika – Toxics and Waste Programme – revealed that approximately 33% of tested samples contained detectable levels of bisphenols, with 10% of samples exceeding the safety thresholds set by authorities. Underwear made from synthetic fibers, such as polyamide and polyester, had the highest concentrations of bisphenols. However, the tests showed that alternatives are available as several products made of synthetic fiber were bisphenol-free. The highest measured concentration in a single underwear sample was 301 mg/kg, which exceeds the threshold set by the Scientific Committee on Consumer Safety (SCCS) of 0.8 mg/kg by more than 350 times. On average, the bisphenol content in samples containing these chemicals was 11.0 mg/kg, with some of the most concerning products containing a mix of bisphenols, including BPA, BPS, and BPF.

Our testing found women's underwear to be at the highest risk, with 50% of women's products containing bisphenols and 17% containing high levels of bisphenols of concern. In contrast, only 9% of men's underwear and 4% of boys' products contained similarly high levels. Girls' underwear

also showed higher exposure potential, with a significant proportion containing bisphenols, particularly in synthetic materials.

The study also examined whether bisphenols could be washed out of underwear. Sixteen samples with the highest bisphenol concentrations were selected for washing and re-testing. Most of the samples were women's products. When analyzing the average total bisphenol content, the results showed an overall reduction of bisphenols by 74%.

However, the individual results were more complex. While some samples showed a 90-99% reduction in bisphenol levels, others remained unchanged, and four samples exhibited higher bisphenol levels after washing. This phenomenon is most likely due to the migration of bisphenols from one part of the underwear to another during washing.

Overall, the data indicates that washing underwear reduces the risk of bisphenol exposure for the wearer. However, this also suggests that bisphenols may pollute the environment if not fully removed from the wastewater. In addition, all samples were still classified as high-risk even after washing. Although the reduction of bisphenols in the underwear was significant, the initial concentrations were so high that, after washing, all 16 products still contained more than 0.8 mg/kg of bisphenols.

The paper combines research findings with a consumer survey conducted across several European countries. With 2,200 respondents, the survey reveals a strong desire for more information about chemicals, significant concern about health and environmental risks, and most imperative, overwhelming support for stricter regulations on harmful substances. Furthermore, a majority of consumers indicated that if they were aware of the presence of toxic chemicals in a product, they would actively avoid purchasing it.

Given these findings, the policy paper calls for an EU-wide ban on bisphenols and their derivatives with endocrine, reprotoxic, or sensitizing properties in textiles and all other consumer products by 2029, greater transparency through the Digital Product Passport, and enhanced regulations for ecolabel certifications. The recommendations also include mandatory pre-market testing and labeling for products containing harmful chemicals and targeted campaigns to raise consumer awareness about the risks of bisphenols.

Environmental and Health Risks of Bisphenols

Bisphenols are integral to the textile industry, particularly in the post-treatment of synthetic fabrics like polyamides. These chemicals, including Bisphenol S (BPS) and Bisphenol F (BPF), enhance color fastness and durability. According to Ramboll Deutschland GmbH (2021), 700-800 tons of BPS are produced annually in textile auxiliaries within the EU. Given the widespread use of recycled polyamides in the textile industry, the presence of bisphenols is unavoidable. The service life of these textiles can range from 6 months (clothing) to 10 years (carpets) (39). However, the potential health implications, particularly concerning skin exposure, demand careful consideration.

BPA and other bisphenols are considered endocrine disruptors that can disrupt the hormonal system in living organisms. By imitating or inhibiting natural hormonal functions, bisphenols can lead to a variety of adverse health effects, especially during critical developmental stages such as pregnancy and early childhood. Newborn and infant exposure to bisphenol A (BPA), in particular, increases the sensitivity of hormone-sensitive organs in later-life exposures to estrogens (47, 24) or chemical carcinogens (33, 27). Health effects linked to BPA exposure include reproductive system disorders, impaired neurological development, an increased risk of chronic diseases like diabetes and cancer, and potential impacts on obesity and metabolic processes (46, 7). Studies on animals (40) and epidemiological studies on human health effects (5, 45) show that BPA can affect brain development, leading to behavioral impacts in children. Exposure can also increase anxiety, depression, hyperactivity, and inattention (4) and negatively affect reproductive functions (37).

Endocrine disruptors are substances that can interfere with the hormonal system. While they are not acutely toxic when ingested in small amounts, they are suspected to have adverse effects even at extremely low doses, acting at nanogram levels, much like natural human hormones. Studies in animals have shown estrogenic effects of bisphenols, particularly at high doses in rodents, leading to damage to reproductive organs, kidneys, and liver, as well as impairment of the immune system and metabolism. Bisphenols have also been linked to the early onset of puberty. Structurally, like the hormone estrogen, bisphenols disrupt the human hormonal system by mimicking or interfering with natural hormonal processes.

Numerous studies have investigated the migration of bisphenols from consumer goods, such as water bottles and children's toys, confirming their migration and the resulting exposure risks to consumers (42). Brandsma et al. (3) studied the migration of BPA in toys purchased within the European Union and manufactured from recycled polymeric materials, using artificial saliva to simulate 1 hour of mouthing. They identified a migration rate of up to 128 ng/cm²/h (nanograms per square centimeter per hour) and an estimated daily BPA intake of 72.4 ng/kg of body weight. Wang et al. (48) revealed the migration of BPA, BPS, BPAP, and BPAF from polycarbonate and polyethylene terephthalate bottles into water. Similarly, Siddique et al. (41) examined the migration of bisphenols in 20 brands of baby bottles, detecting low concentrations of BPA and BPS in the leachate, with average levels of 31.5 ng/L and 2.33 ng/L, respectively, in the water simulant.

Nevertheless, the authors stress that, despite the low concentrations, the diminished metabolic capacities of newborns and children may lead to increased and potentially more harmful bioaccumulation compared to adults. **One must consider these substances' possible migration and dermal uptake to assess the risk of bisphenol content in textiles. Bisphenol A (BPA) has been proven to migrate from clothing into artificial sweat (43), and there is no doubt about the possibility of dermal uptake (10).**

BPA enters the environment from specific point sources, such as leachates from landfills (34), and a wide range of diffuse sources related to their usage. Moreover, the released BPA leaches into wastewater, where current treatment plants face significant challenges in completely degrading the substance (1, 30). Consequently, BPA enters surface and groundwater, posing a significant threat to aquatic ecosystems and triggering disruptive effects on their endocrine system (51, 28, 52, 38). Numerous scientific papers have documented the widespread presence of BPA in surface waters and its disruptive impact on local aquatic ecosystems, as evidenced by research on the Ganga River in India (31), in Canadian Mille Iles River and St. Lawrence River (23) surface water in Southwestern Nigeria (25) or Ebro Delta in Spain (22). It has also been found in beach sand worldwide, originating from plastic marine waste (32).

Bisphenols in textile: "Textile auxiliaries that contain BPS and BPF are used as colour fixers for polyamide textiles to provide longevity of colour. Globally, 80% of polyamide textiles undergo colour fixing with syntans. Stakeholders reported an annual production of BPS of 700 – 800 tonnes for textile auxiliary production in the EU (Ramboll Deutschland GmbH, 2021). The textile auxiliaries are specifically post-treatment (anionic-after treatment – fixation of dyes) agents for polyamide (spandex, elastane). When using recycled polyamide, effective posttreatment with these auxiliaries is required. Without this after-treatment, recycled polyamide can no longer be used to produce textiles because standards for colour fastness are not adhered to. BPS/BPF is used in chemical production as raw material for synthesizing textile auxiliaries and is an unavoidable substance residue in products. The duration of service life is from 6 months (clothing) up to 10 years (carpets). "(11)

Bisphenol Restrictions in the EU

ASSESSING GROUPS OF BISPHENOLS

To avoid situations where one hazardous bisphenol is replaced with another equally harmful substitute, ECHA, and the Member States have assessed 148 bisphenols as a group.

The authorities found that 34 bisphenols may need to be restricted under the EU's chemicals legislation, REACH, as they may interfere with hormonal systems and affect reproduction. Either identification as substances of very high concern (SVHCs) or harmonised classification and labelling is proposed as a first step for these bisphenols to manage their risks. This number may change as more information is generated for these and other bisphenols lacking data.

Twenty-six bisphenols are not suspected to be endocrine disruptors or toxic to reproduction. These bisphenols may still be regulated in consumer products because most are skin sensitisers. Many group members need more data before their potential for endocrine-disrupting and reprotoxic properties can be assessed. (8)

However, up to now, only BPA is subject to significant restrictions within the European Union due to its classification as a substance of very high concern (SVHC) under the REACH Regulation. This classifi-

cation is primarily based on BPA's well-documented properties as an endocrine disruptor (EDC), which can interfere with hormonal systems and lead to adverse health effects, particularly in reproductive and developmental contexts. BPA is classified as toxic for reproduction (Category 1B), highlighting its potential to impair fertility and harm the unborn child, and as a skin sensitizer (skin sens. 1 – may cause skin allergies) under the CLP Regulation (EC No 1272/2008).

Further emphasizing the growing concern over BPA's safety, in 2023, the European Food Safety Authority (EFSA) reduced the Tolerable Daily Intake (TDI) for BPA from 4 µg/kg bw/day (micrograms per kilogram of body weight per day) to 0.02 ng/kg bw/day, which constitutes a TDI reduction by 20,000 times. This significant reduction reflects the increasing awareness and recognition of the risks associated with BPA exposure (9).

However, the regulatory landscape remains complex, with variations in restrictions across different countries and product categories, which highlights the need for ongoing vigilance. To address these concerns, the EU has implemented specific restrictions on BPA in various consumer products, ensuring that exposure is minimized, and public health is protected:

BABY BOTTLES

In January 2011, the European Commission prohibited using BPA to manufacture polycarbonate infant feeding bottles (14).

BPA was banned in plastic bottles and packaging containing food for babies and children under three years from September 2018 (16).

PLASTIC FOOD CONTACT MATERIALS

BPA and BPS are authorized for use as a monomer in plastic food contact materials according to the EU Regulation EC10/2011 (6). This Regulation contains a positive list of allowed monomers. No other bisphenol is on this list, which equals a ban on their use (6).

On June 12, 2024, the EU Expert Committee approved a proposal from the European Commission to prohibit the use of bisphenol A (BPA, CAS 80-05-7) and other bisphenols and their derivatives with harmonised classification for specific hazardous properties in food contact materials (18). This decision was driven by the European Food Safety Authority's (EFSA) findings, which indicated that BPA could have detrimental effects on the immune system. The ban will primarily impact the use of certain bisphenols, including BPA, in packaging, such as can coatings, reusable plastic bottles, and kitchenware. Pending final approval by the European Parliament and the Council, the ban is expected to be implemented by the end of 2024. Following its enactment, there will be an 18-month transition period for single-use food contact items, with exceptions for canned fish, fruit, and vegetables, as well as the exterior of canned foods, with a 36-month transition period. Food retailers will have 12 months to deplete their stock after the transition period ends. Reusable items and machinery will be allowed to remain in use until they reach the end of their natural lifespan (20).

In France, BPA is banned in all food packaging, containers, utensils, teethers, and soother shields (21). In Austria, it is prohibited to manufacture pacifiers and teething rings with BPA or place them on the market, following Federal Law Gazette Part II, No.327/2011 (2).

Other countries like Denmark, Belgium, and Sweden banned BPA in food contact materials containing food intended for infants and children of 0-3 years, such as infant formula and baby food in jars or bags.

CHILDREN TOYS

According to the EU Toy Safety Directive (2009/48/EC), there is a limit on the amount of BPA that is allowed to leach out of toys for children up to the age of three and in any toys that are intended to be placed in a child's mouth. These toys can only be used if they comply with the migration limit of 0.04 mg/l of BPA, as set by the methods outlined in EN 71-10:2005 and EN 71-11:2005.

Following the EU Toy Safety Directive, chemicals classified as carcinogenic, mutagenic, or toxic for reproduction (CMR) in categories 1A, 1B, or 2 under Regulation (EC) No 1272/2008 shall not be used in toys, toy components, or micro-structurally distinct parts of toys. The updated Annex VI of the EU Toy Safety Directive (2009/48/EC), which comes into force on December 1, 2025, includes bisphenol A, bisphenol S, and bisphenol AF as chemicals with reproductive toxicity (1B) and bans their presence in toys (12).

THERMAL PAPER

Since 2020, the use of BPA in thermal paper has been restricted in the EU under REACH, with a concentration limit of 0.02% (200 mg/kg).

COSMETICS

Bisphenols classified as Reproductive Toxins fall under Carcinogenic, Mutagenic, and Reproductive Toxic substances (CMR) and are prohibited from use in cosmetics. (8)

OTHER PROPOSALS

- On 7 October 2022, the German authorities submitted a dossier to the European Chemicals Agency (ECHA) proposing group restrictions on Bisphenol A and other bisphenols of environmental concern (including BPS, BPB, BPF, and BPAF) (8). Following the conclusion of the six-month public consultation period, which ran from December 2022 to June 2023, stakeholders provided significant new data regarding the emissions and uses of the bisphenols covered in the dossier. Consequently, the German authorities temporarily withdrew the dossier to allow for careful redrafting and further third-party consultation (13).
  This decision to temporarily withdraw the dossier was met with opposition from scientists, who described the move as threatening public health and urged the German government to resubmit the proposal to restrict bisphenols (29).
- France and Sweden have proposed restrictions on over 1000 skin-sensitising chemicals in clothing, footwear, and other articles, with a proposed limit of 130 mg/kg, which is higher than the limit suggested by the Scientific Committee on Consumer Safety (SCCS) (6).

Certificates

In response to serious health concerns associated with BPA, various certifications and regulations have been established within the European Union to monitor, limit, or entirely prohibit the presence of BPA and other bisphenols in consumer products.

OEKO-TEX® STANDARD 100

BPA Limits: The OEKO-TEX® Standard 100 specifies strict limits for harmful chemicals, including BPA. The BPA limits can be very low or even zero depending on the product class (e.g., infant products, children's clothing). These limits are periodically updated to reflect the latest scientific findings.
The limit value for Bisphenol-A (PC I-IV) in the criteria catalogues Annex 4 and 6 of STANDARD 100 by OEKO-TEX® is reduced to the following: - Bisphenol-A: 100 mg/kg (PC I-IV) (35).

GOTS (GLOBAL ORGANIC TEXTILE STANDARD)

BPA Restrictions: GOTS prohibits the use of BPA in certified organic textiles. GOTS certification ensures that products are made without harmful chemicals, including bisphenols, which is particularly important for textiles that come into contact with skin.

Bisphenol A and all other plasticisers with endocrine-disrupting potential are prohibited in textiles (26).

EU ECOLABEL

BPA Limits: The EU Ecolabel includes criteria that restrict the presence of BPA in products. Products meeting the EU Ecolabel standards must demonstrate that BPA is either unused or present only under strictly defined limits to ensure consumer safety.

Bisphenol A and all other plasticisers with endocrine-disrupting potential are prohibited in textiles (15).

OTHER CERTIFICATES

Blue Angel (Blauer Engel) sets stringent limits on the presence of BPA in products, particularly in textiles and consumer goods. Products bearing this label must prove they are free from harmful substances, including BPA. The Austrian Ecolabel has been established in cooperation with the Blue Angel; the criteria are, therefore, fully harmonised.

The Nordic Swan Ecolabel has strict criteria for chemicals that are harmful to health and the environment, including BPA. The limits are designed to minimize BPA exposure and protect consumers. **Cradle to Cradle Certified** certification evaluates products based on their environmental and health impact across multiple criteria. Bisphenols like BPA are restricted or banned, especially in products intended for high human contact. The limits ensure that products are safe throughout their entire lifecycle.

Table 1: Examples of restrictions on bisphenols used in consumer products

	Limit (mg/kg)	Substances
German proposal to ECHA[2]	10	Includes BPA, B, S, F, AF
Scientific Committee on Consumer Safety[3]	0.8	BPA
Blue sign[4]	BPA -1 for baby articles,10 for rest. 100 for other BPs	Lower limit for BPA; Higher limit for BPS, F, AF
H&M[5]	1 for BPA; 200 for others	Lower limit for BPA; Higher limit for BPB, S, F, AF
	Limit (mg/kg)	**Substances**
the Apparel and Footwear International RSL Management (AFIRM) Group [6]	1	BPA (BPS, F and AF should be tested/reported but have no limit)
G-Star[7]	1 for garment (50 for accessories)	BPA
OEKO-TEX[8]	100	BPA (BPS; BPF and BPAF under observation) Also in leather

2 **https://echa.europa.eu/da/registry-of-restriction-intentions/-/dislist/details/0b0236e1853413ea**

3 **https://health.ec.europa.eu/system/files/2022-08/sccs_o_240.pdf**

4 **https://www.bluesign.com/en/downloads/** under RESTRICTED SUBSTANCES LIST (RSL).Version15.0

5 **https://hmgroup.com/wp-content/uploads/2022/01/HM-Group-Chemical-Restrictions-Textile-Products-Accessories-Footwear-Belts-and-Bags-2022.pdf**

6 **https://afirm-group.com/wp-content/uploads/2022/02/2022_AFIRM_RSL_2022_02161.pdf**

7 **https://img2.g-star.com/image/upload/v1483974908/CSR/PDF/G-Star_RAW_-_RSL_Garments_Version_2.0_online.pdf**

8 **https://www.oeko-tex.com/importedmedia/downloadfiles/OEKO-TEX_STANDARD_100_Standard_EN_DE.pdf** (version 03-2024)

Test Program

The test program was meticulously designed to ensure comprehensive coverage of various consumer groups and material types (see Table 2). One hundred sixty-six tested products were selected based on material composition, color, and style, reflecting the diversity of the market. The analysis involved LC-MS/MS after extracting the sample with acetone and dichloromethane (1:4) to accurately measure bisphenol content in different textiles. The findings provide crucial insights into the prevalence of bisphenols in everyday clothing, particularly underwear.

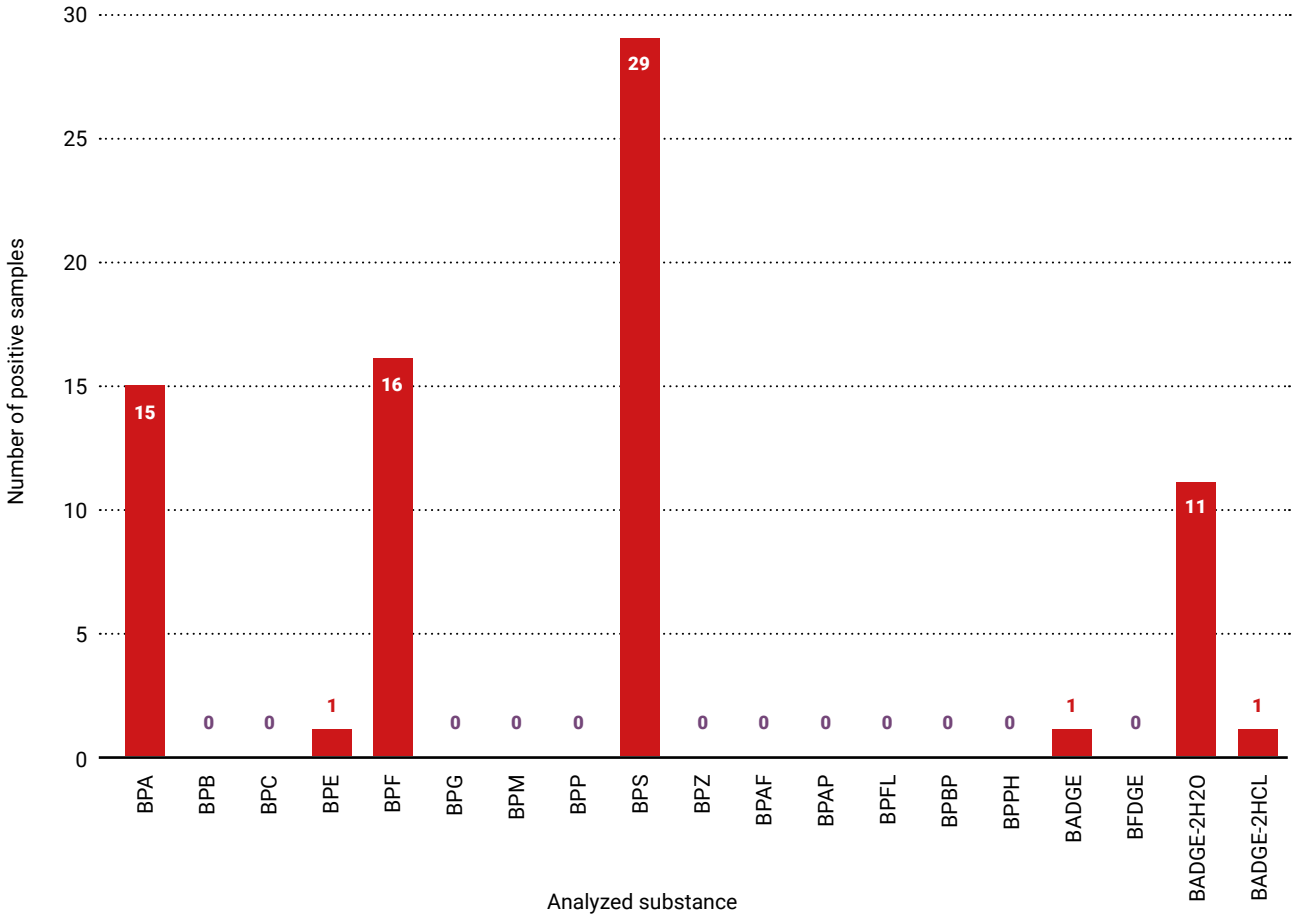
Table 2: Samples description

Consumer group	Material	Color	Style	Number of samples
Adult women	Focus on synthetic materials	Light colors (nude, rose, lavender, white)	Classic styles such as briefs or hipsters, no strings	66
Adult men	Focus on cotton	Dark, preferably black	Pants with short legs	47
Children – girls (pre-teen and teen)	Depending on the market	Colorful, light	Classic briefs or pants	26
Children – boys (pre-teen and teen)	Depending on the market	Colorful, depending on the market	Pants with short legs	27

Results and Evaluation

The study results reveal significant variations in bisphenol content across different product categories. Approximately one-third (33 %) of the tested samples contained detectable levels of bisphenols, with 10 % containing amounts above the SCCS threshold of 0.8 mg/kg. Particularly concerning is the presence of bisphenols in products made from synthetic fibers, where concentrations were often significantly higher. For instance, one sample contained a sum of bisphenols as high as 301 mg/kg, which is 0.03 % of the product's weight, which exceeds the threshold set by the Scientific Committee on Consumer Safety (SCCS) of 0.8 mg/kg by more than 350 times. On average, we measured 11.0 mg/kg of bisphenols in the samples that contained bisphenols.

Figure 1 : Overview of the frequency of bisphenols in 166 samples



The evaluation criteria were based on the maximum allowable limits set by SCCS, with samples categorized into 'red,' 'yellow,' and 'green' based on their bisphenol content (19):

Table 3: Evaluation criteria

Content of bisphenols above the maximum amount of BPA in textiles to protect human health calculated by SCCS (0,8mg/kg)
Content below the SCCS calculated max. amount of BPA, but 10 times above LOD/almost 100 times below the SCCS limit (0,01mg/kg<x<0,8mg/kg)
No content or content almost 100 times below the maximum limit of BPA calculated by SCCS (<0,01mg/kg)

The detailed evaluation highlights the potential health risks associated with bisphenol exposure through clothing, especially for women and children.

Table 4: Bisphenol concentrations

Product Group	Total
Substances found	BPA, BPE, BPF, BPS, BADGE, BADGE-2H2O and BADGE-2HCl
Mean sum of all bisphenols/sample (mg/kg)	11.0
Mean sum of bisphenols of high concern/sample (mg/kg)	11.4
Lowest sum of all bisphenols/sample (mg/kg)	0.0
Highest sum of all bisphenols/sample (mg/kg)	301.190
Number of samples with bisphenols	53
Number of samples with bisphenols of high concern (BPA, BPB, BPS, BPF, BPAF)	47

Table 5: Bisphenol concentrations by product groups

Product Group	Girls	Boys	Men	Women
Substances found	BPA, BPS and BADGE-2H2O	BPS, BADGE and BADGE-2HCl	BPA, BPE, BPF and BPS	BPA, BPF, BPS and BADGE-2H2O
Mean sum of all bisphenols/sample (mg/kg)	4.6	0.039	13.8	25.5
Mean sum of bisphenols of high concern/sample (mg/kg)	3.2	0.018	13.7	28.8
Lowest sum of all bisphenols/sample (mg/kg)	0.015	0.015	0.0	0.012
Highest sum of all bisphenols/sample (mg/kg)	27.090	0.120	65.000	301.190
Number of samples with bisphenols	6	5	8	34
Number of samples with bisphenols of high concern	5	4	8	30
Number of “red” samples	1	0	4	11
Number of “yellow” samples	5	5	4	23
Number of “green” samples	19	21	37	30
Total number of samples	25	26	45	64

RESULTS PER SAMPLE GROUPS

Products for girls: Three-quarters of the products for girls were free of bisphenols. 4% contained high amounts of bisphenols – this is one sample made of only synthetic material (mainly Polyamide).

Products for boys: 81% of the products for boys were free of bisphenols. No sample for boys contained high amounts of bisphenols. We detected less bisphenols in products for boys than in those for girls. Products for boys were all manufactured with high percentages of cotton and lower percentages of synthetic materials. This fact contributed to positive results of boys' underwear. See more about this in the evaluation based on the material.

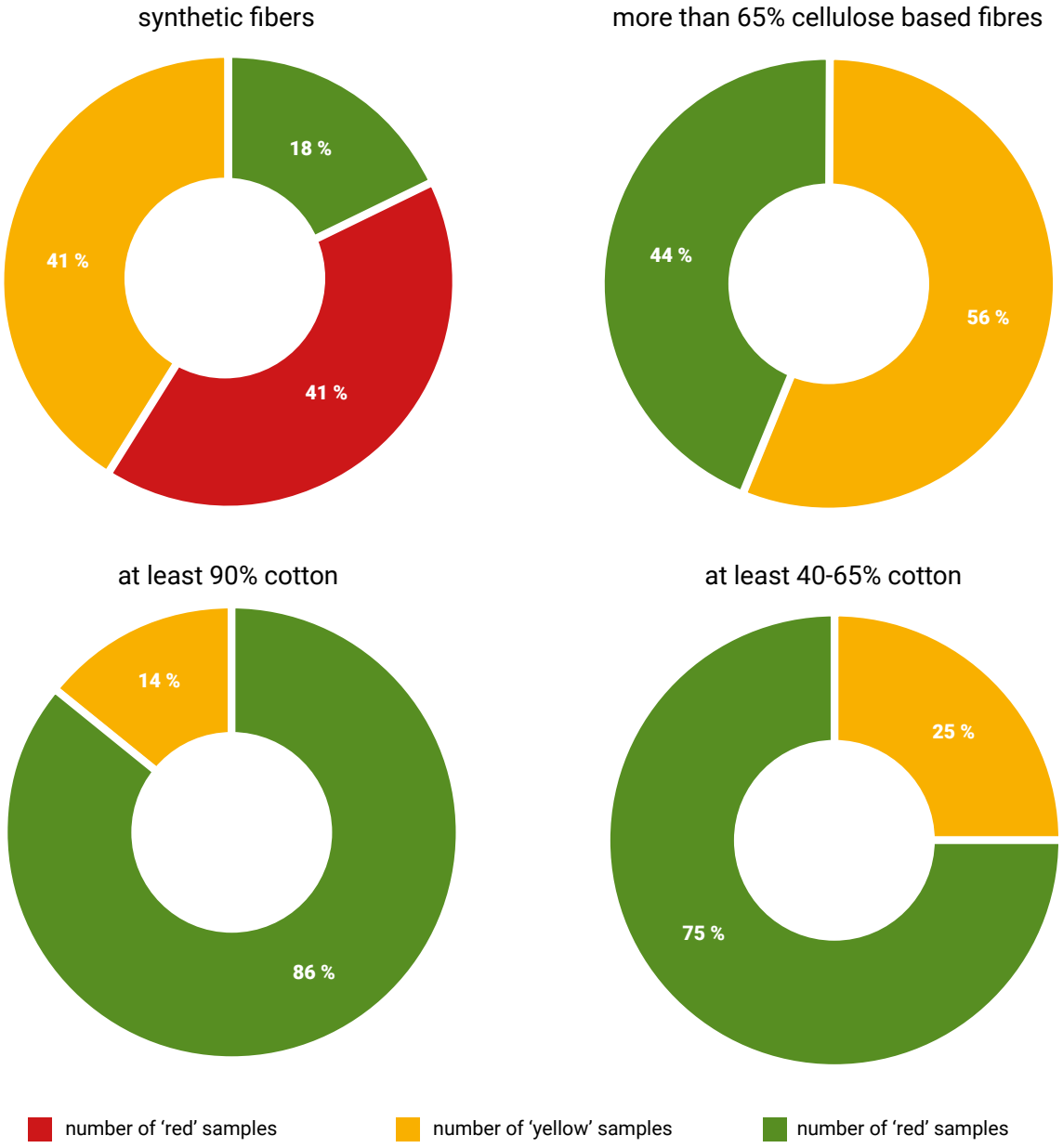
Products for men: 82% of the products for men were free of bisphenols. 9% contained high amounts of bisphenols. All samples with high amounts of bisphenols were made of synthetic material.

Products for women: The highest percentage of products with bisphenols were detected in the category for women. More than 50% contained bisphenols, and 17% contained high numbers of bisphenols. Except for 1 sample, all "red" samples are made of mostly synthetic material. While there are also cotton products available for women, our market research showed that, in general, women's products are manufactured with higher percentages of synthetic materials. These elevated levels put women at higher risk of bisphenol exposure through underwear.

The most commonly used materials in the underwear samples were cotton, polyamide, polyester, cellulose fibers (modal, lycoll, bamboo), and elastane. Products were grouped into categories depending on their material composition.

Figure 2: Evaluation based on material

Figure 3: Evaluation based on material



- Products with at least 90% cotton: These products additionally contain synthetic fibers mainly to allow for elasticity in the waistband.
- Products with 40-65% cotton: The remaining material is mostly natural fibers (cellulose based) and small amounts (less than 10%) of synthetic fibers; only 1 sample contains 31% polyester.
- Products made from at least 65% percent cellulose-based fibers: These can be made from wood pulp or bamboo; common fiber names are modal, lyocell, or tencel. The rest of the material is mainly cotton and small amounts (less than 10%) of synthetic fibers. One sample contains 14% silk.
- Products made of synthetic fibers contain a mix of polyamide, polyester, and elastane. Some of these products are equipped with a cotton liner - this does not guarantee better results.
- One product in the test is made from 95% wool and 5% elastane. This product did not contain bisphenols.

The above figure (Figure 3) clearly shows that underwear made with a high content of synthetic fibers raises the risk of bisphenol exposure. This underwear type is the only product group with samples rated "red," – meaning they contain more bisphenols than the SCCS sees as the threshold for human health protection. In the group of products made with a higher percentage of cellulose-based fibers, we detected significantly more bisphenols than in the two groups with higher cotton content.

Table 6: Evaluation based on point of sale. The following shop categories were agreed upon.

Shop Category	Examples
Physical Shops	H&M, C&A, Intimissimi,...
Online Marketplace	Amazon, Shein,...
Discounter	Aldi/Hofer, Lidl, Takko, Pepco, Kik, NKD,...
National Store	online or physical
Cheap Market	physical market with cheap no-brand named products,...

Our evaluations based on sample purchase origin show that products with a high percentage of cotton are most likely to contain no bisphenols, no matter where they were bought.

Products bought in physical stores and online marketplaces paint the same picture. Based on the data, the material is the only criterion that matters when it comes to bisphenols.

Figure 4a: Results based on point of sale

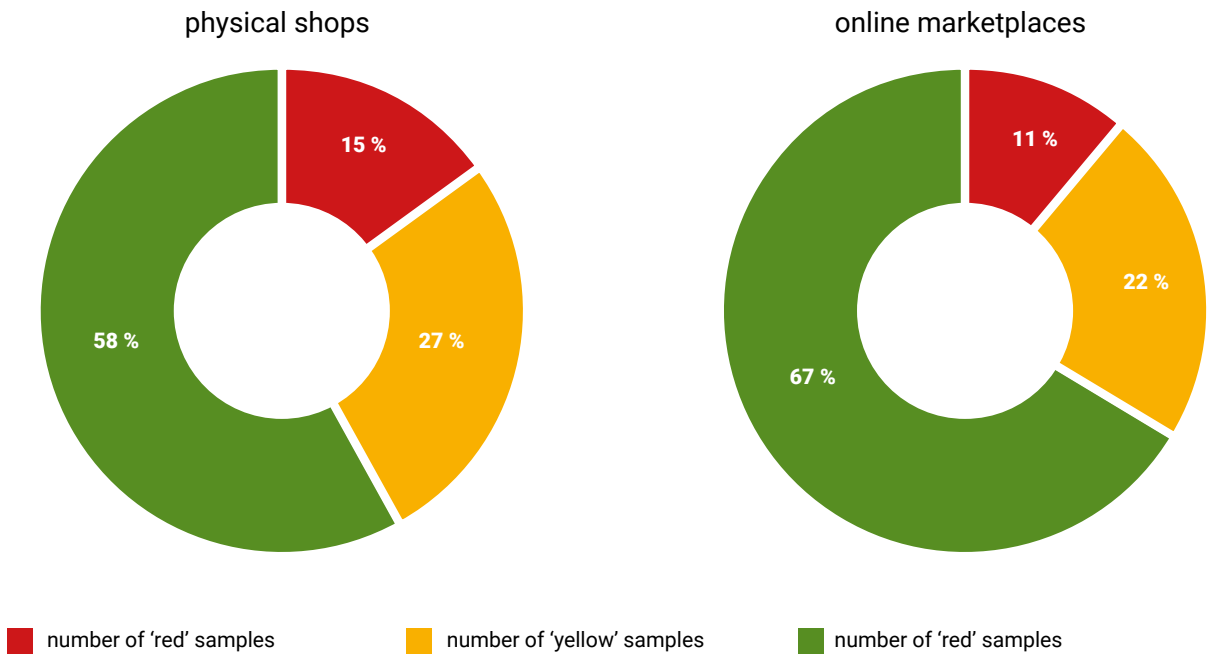
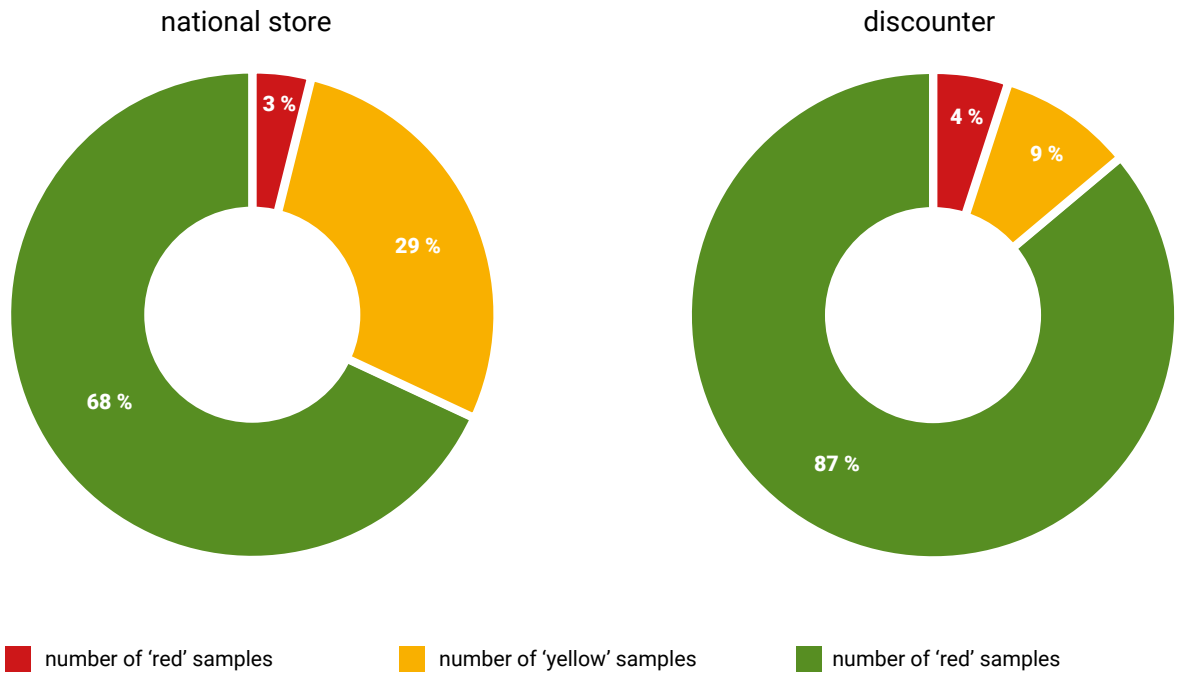


Figure 4b: Results based on point of sale



EVALUATION OF WASHED SAMPLES

The 16 samples selected for washing and re-testing had the highest amounts of bisphenols detected. They were mainly women's products.

Table 7: Samples for washing

Product Group	Number of Samples
Girls	1
Boys	0
Men	4
Women	11
Total	16

When looking at the mean sums of bisphenols detected (or the mean sum of bisphenols of high concern), the results clearly show a reduction of bisphenols overall of 74%.

Table 8: Comparison of washed and unwashed samples

Product Group	Unwashed	Washed
Substances found	BPA, BPE, BPF, BPS, BADGE, BADGE-2H2O and BADGE-2HCl	BPA, BPE, BPF, BPS, BADGE, BADGE-2H2O and BADGE-2HCl
Mean sum of all bisphenols/sample (mg/kg)	62.5	16.3
Mean sum of bisphenols of high concern/sample (mg/kg)	61.7	16.0
Lowest sum of all bisphenols/sample (mg/kg)	1.2	1.0
Highest sum of all bisphenols/sample (mg/kg)	301.2	40.3
Number of "red" samples	16	16
Total number of samples	16	16

When looking at each sample, the picture is more complex. While in some samples, a reduction of 90-99% of bisphenols was achieved, four samples showed higher values of bisphenols than before washing. According to the lab, this phenomenon can be explained by the leaching of bisphenols from one part of the underwear to another during washing. Since all products were made of different materials, the chemical analysis was performed on a combined sample (see test program for details). However, it is possible that some synthetics (like thread in a seam) were not present in that mixed sample. Also, since the ratio of elastic waistband to main fabric is very low, these parts of the underwear did not impact the initial result highly. The increase in bisphenols after washing suggests that the initial result (before washing) may have been lower than the actual bisphenol content. Since it is currently not feasible to test the entire garment for bisphenols, our initial test results are the closest approximation to the 'true' bisphenol content. The data shows that washing underwear decreases the wearer's risk of contact with bisphenols. However, this also means the bisphenols can pollute the environment if not entirely removed in wastewater treatment.

In addition, all samples were still rated "red" after washing. Therefore, while the reduction of bisphenols in the underwear was significant, the initial values were so high that after washing all 16 products, they still contained more than 0.8 mg/kg bisphenols.

COMPARISON WITH OTHER STUDIES

The results of this study were compared with findings from other scientific papers. The study's results by Xue (50), based on 52 samples of infant clothing, identified a similar bisphenol profile, with BPA and BPS being the most prevalent compounds. In our sample set, BPS was the most frequently detected (in 29 samples), followed by BPA (17 samples), BPF (16 samples), and BADGE-2H2O (12 samples). The average concentration of BPA in this study (0.0737 mg/kg) was significantly lower than that reported by group Xue (0.499 mg/kg). The average value for BPF was 1,000 times higher than the mean value reported in the comparative study (9.3385 mg/kg compared to 0.00965 mg/kg).

Similarly, for BPS, our results showed concentrations of 28.97 mg/kg, nearly 1,500 times higher than the 0.0199 mg/kg reported in the other study. These results were compared across the entire sample set, including adult clothing samples. The tested 53 samples of underwear revealed five positive samples containing BPA (with a mean of 0.156 mg/kg, which is more than 3 times lower than the comparative study, where the mean was 0.499 mg/kg) and five positive samples containing BPS (with a mean of 2.5 mg/kg, which is 125 times higher than the BPS values found in clothing in the Xue study—0.0199 mg/kg, primarily due to the high result of 15 mg/kg in one girl's sample).

Similarly, our results are higher than those found in clothing samples purchased in China (49). The BPA concentration is four times higher than in the compared study (0.0737 mg/kg compared to 0.0177 mg/kg), and for BPS, the concentration is more than twice as high (28.97 mg/kg compared to 12.3 mg/kg).

SUMMARY

- Bisphenols were detected in every 3rd sample. Almost all of these samples contained at least one bisphenol of high concern, which means that this substance is part of the restriction proposal to ECHA.
- Products made from polyamide are most likely to contain bisphenols. Cellulose-based fibers also contain higher amounts of bisphenols than cotton but less than synthetic fibers.
- Women's products are most likely to be made of synthetic materials; therefore, women's products pose the highest risk of exposure to bisphenols. Underwear for pre-teen and teen girls is more likely to be made of a high percentage of synthetics than underwear for boys or men. Thus, pre-teens and teenage girls have the second highest risk of being exposed to bisphenols through their underwear.
- We can advise parents to buy mostly cotton underwear for their children as long as possible.
- The point of sale was not found to impact the content of bisphenols. Products from cheap markets made of 95% cotton and 5% elastane also contained very little bisphenols.
- **Key takeaway: To avoid bisphenols in underwear, buy majority-cotton products.**

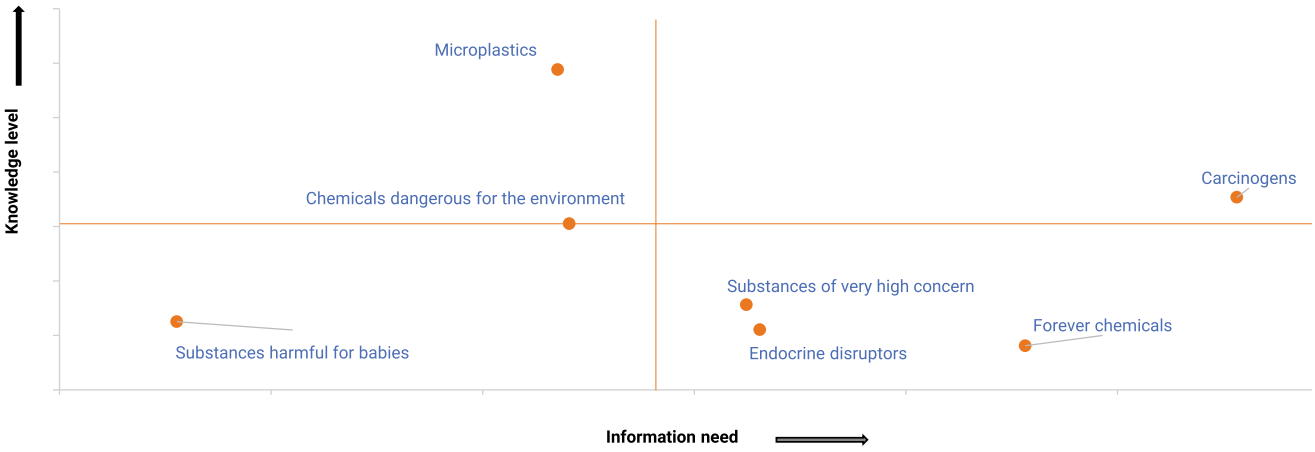
Consumer Awareness of Harmful Chemicals

Consumer awareness regarding harmful chemicals in everyday products is critical in driving regulatory change. A recent survey conducted across Austria, Hungary, Slovenia, the Czech Republic, and Slovakia from February to March 2024 provides valuable insights into consumer perceptions, knowledge levels, and behavioral responses concerning harmful chemicals in consumer products. With 2,200 respondents, the survey reveals a strong desire for more information about chemicals, significant concern about health and environmental risks, and overwhelming support for stricter regulations on harmful substances.

The survey results indicate that consumer awareness of harmful chemicals varies widely across chemical categories. Respondents showed the most interest in carcinogens (83%), forever chemicals (78%), and endocrine disruptors (72%). However, despite the strong interest, self-reported levels of knowledge were moderate, signaling a gap between concern and awareness. This underscores the need for targeted educational efforts to increase consumer understanding of the risks posed by specific chemicals in consumer products.

However, consumer awareness, knowledge, and the ability to change behavior depend on many individual factors, such as education, consumer literacy, welfare situation, or access to alternatives. Therefore, demand-side interventions can only bring uneven and partial results in protecting human environmental health.

Figure 5: MAP on the level of information versus the need for more information.
Base: All respondents, N=2200. Information need in %. Knowledge level based on a 1-10 scale.
Source: ToxFree LIFE for All, 1st Impact report, February - April 2024



Consumers are not only interested in harmful chemicals but also seek actionable information. Most respondents want to know:

- Which substances pose specific risks (75%),
- How to identify safer alternatives (62%).

This need for transparency translates directly into changes in consumer behavior. When confronted with the knowledge that a product contains harmful chemicals, 35% of respondents stated they would stop purchasing the product if no substitute were available, while 28% indicated they would actively avoid buying such products.

Consumers overwhelmingly support stricter regulations on harmful chemicals:

- 67% of respondents favored a complete ban on harmful substances in products,
- 65% advocated for clear labeling and notification systems to warn consumers about the presence of harmful chemicals,
- 63% believed all products should be tested and certified before entering the market.

The survey “Attitudes of Europeans to the Environment” highlights substantial concern about harmful chemicals in everyday products, with 84% of respondents worried about their effects on health and the environment. Moreover, 72% of Europeans consider chemical safety when making purchases, and over half (52%) believe that current levels of protection against harmful chemicals are too low and need improvement.

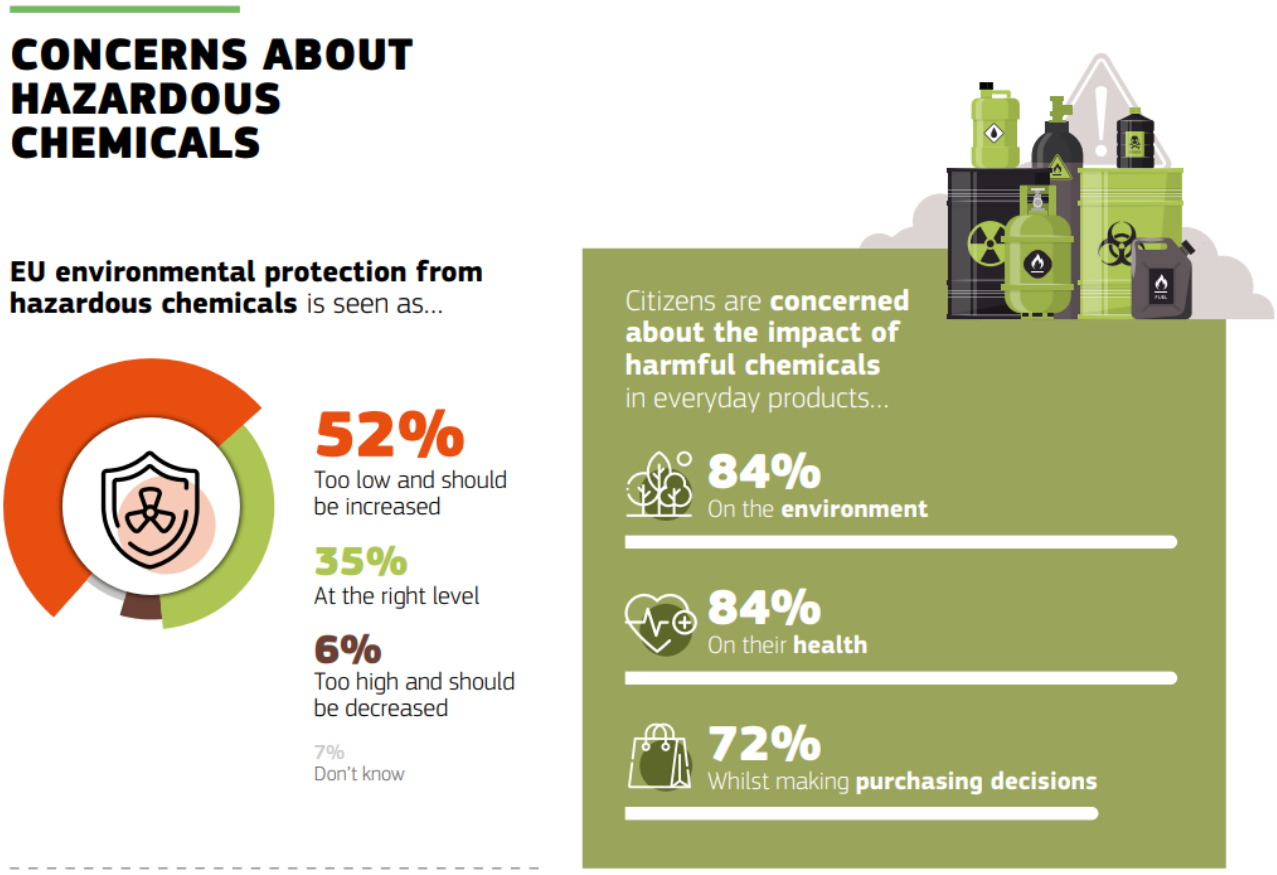
These findings suggest readiness to support regulatory frameworks aimed at reducing exposure to harmful chemicals in consumer products.

Specific product categories emerged as areas of significant concern among consumers. The top categories for which consumers expressed interest in knowing about harmful chemical content include:

- Food packaging (87%),
- Household cleaning products (79%),
- Kitchen utensils (79%),
- Cosmetics (74%),
- Adult clothing (66%).

Previous test campaigns revealed bisphenols contamination in food contact materials, including the plastic coating of food cans or polycarbonate plastics.[9] These product categories are in direct contact with consumers daily, reinforcing the need to prioritize regulatory actions in these sectors.

Figure 6: Attitudes of Europeans to the environment. Special Eurobarometer 550. Fieldwork: March-April 2024. Source: **https://europa.eu/eurobarometer/surveys/detail/3173**



9 BEUC blog. Hormone-disrupting chemicals found in 60% of 121 children's products - Consumer Corner. 31 May, 2023. Available at **https://www.beuc.eu/blog/hormone-disrupting-chemicals-found-in-60-of-121-childrens-products/**

Other notable areas of concern include children's products, such as toys (50%) and clothing (47%), which warrant additional scrutiny due to their direct exposure to vulnerable populations.

The ToxFree LIFE for All project survey results align with the findings of the Special Eurobarometer 550 – "Attitudes of Europeans to the Environment" (March-April 2024) (17), conducted among 27,000 respondents. The results reveal that more than three-quarters of Europeans (78%) believe environmental issues have a direct impact on their daily lives and health. **Additionally, 84 % of respondents agree that EU environmental legislation is crucial for protecting the environment in their country. There is widespread concern about pollution costs, with 92% of Europeans stating that companies should be responsible for cleaning up their pollution and 74% agreeing that public authorities should also bear part of the cost.**

Policy Actions for Bisphenol Restrictions and Chemical Safety in Consumer Products

As civil society organizations representing public interest in health and environmental protection, we call on all the stakeholders to take immediate action on the following recommendations regarding the **restriction of the bisphenol group of chemicals and its substitution in consumer products**, including textiles:

We call on EU policy makers:

Stop the Use of Bisphenols in Consumer Products:

1. **EU-Wide bisphenol restriction**: We urgently call for adopting a comprehensive, EU-wide restriction on the production and use of all bisphenols across all consumer products placed on the EU market. Given the well-documented harmful effects of certain bisphenols as endocrine disruptors on both human health and natural ecosystems, it is critical to phase them out as quickly as possible and do so for the entire family of bisphenols to avoid regrettable substitution.
   The production and use of BPA and other bisphenols should be strictly limited to only the most essential uses. Any derogation should be limited to essential uses where no alternatives exist and must be time-bound, closely monitored, and regularly reviewed.
2. **Broaden the scope of bisphenols restrictions**: The scope of these restrictions must extend to all bisphenols-containing products, including those currently unregulated, to prevent future environmental and health burdens.
   We express our strong support for Germany's proposal on bisphenol restriction from 2022. However, we urge the resubmission of the proposal with critical adjustments after its withdrawal in 2023. The current list of targeted bisphenols is too narrow; the scope must be expanded to include all bisphenols classified as EDCs to prevent the harmful practice of "regrettable substitution." Additionally, the process for adding substances to the restricted group should be more decisive, avoiding unnecessary delays, with stricter limits and shorter deadlines, particularly for recycled materials.
3. **Ban bisphenols by 2029**: We advocate for a complete ban on the production and use of bisphenols in all consumer products, including textiles, by 2029. In alignment with the Green Deal and the goal of achieving EU climate neutrality by 2050, the immediate removal of hazardous

substances from products intended for recycling is essential. With textile recycling obligation coming into force in 2025, any delay in phasing out bisphenols jeopardizes the quality and safety of materials derived from recycled products. Endocrine-disrupting chemicals like bisphenols are incompatible with the principles of ecodesign and safe recycling, potentially prolonging public exposure and increasing healthcare costs.

4. **Ensure Chemical Safety in Product Sustainability**: Chemical safety is fundamental to product sustainability. We urge the European Commission to uphold its commitments under the Circular Economy Action Plan (adopted in 2020) and the Ecodesign Requirements for Sustainable Products (entered into force in 2024), which prioritize textiles, garments, and footwear. The introduction of the Digital Product Passport must include full transparency and traceability of substances of concern (not only SVHCs) to ensure consumers, downstream users, and recyclers or other waste operators are provided with information on the bisphenols content in waste products. The Commission must fully support the development and swift adoption of a universal bisphenol restriction without delay, ensuring that hazardous chemicals are eliminated from these priority sectors.
5. We call on the EU to support the inclusion of Bisphenol A, recognized as an endocrine disruptor, and other bisphenols as a group, which also show potential as endocrine disruptors, in the Global Plastics Treaty's phase-out list.
6. The EU policy shall include further measures to ensure consumers' right to choose safe products. **Mandatory labelling of hazardous chemicals:** the majority of consumers (75%) strongly want transparency about the substances in products that may pose health or environmental risks. Providing transparent and standardized labels on all consumer goods will enable consumers to make informed, safer choices by identifying harmful chemicals and their associated risks.
7. **Pre-Market Testing and Certification:** We recommend establishing a regulatory framework that mandates independent testing and certification for consumer products, particularly in high-risk categories such as food packaging, children's products, and personal care items.

*We encourage **citizens** to actively demand bisphenol-free products and prioritize purchasing items labelled as bisphenol-free or certified for chemical safety. By making informed choices, consumers can help drive the market towards safer, non-toxic alternatives and contribute to reducing exposure to harmful chemicals.*

*To support consumers, **national policymakers** must respond to their demands for safer products. Our survey results indicate that the most effective actions should focus on transparency, regulation, and consumer protection. Below are examples of actions that could be taken:*

1. **Develop Consumer Awareness Campaigns:** The survey results revealed a significant gap between consumer concern and knowledge. Many respondents want to learn more about chemical risks and safer alternatives. We recommend developing European and nationwide awareness programs that provide clear, accessible information about harmful chemicals, focusing on everyday products. Programs could include online resources, packaging information, and media campaigns targeting households with children and general consumers.
2. **Support for Civil Society and Consumer Advocacy:** Fund and collaborate with consumer organizations to conduct independent testing of products. Promote partnerships between regulatory bodies, NGOs, and industry stakeholders to push for broader awareness and change.
3. **Encourage Industry Innovation:** Introduce financial incentives for companies investing in research and development of non-toxic, sustainable alternatives to harmful chemicals. Encourage the use of safer chemicals in manufacturing, especially for products used by children and vulnerable populations.

We encourage politicians from all countries around the globe to take global action against toxic chemicals including bisphenols:

1. **Take the Global Leadership**: We urge EU policymakers as well as politicians from all over the world to ban harmful chemicals like bisphenols, using the framework UN instruments such as the Intergovernmental Negotiating Committee to develop an international legally binding instrument on plastic pollution: and other international environmental agreements.
2. **Engage in Citizen Awareness Raising Campaigns**: We encourage EU institutions to launch public campaigns aimed at raising consumer awareness about the risks of bisphenols. Such campaigns should emphasize the health and environmental impacts and promote demand for bisphenols-free products across Europe.

Manufacturers and retailers should act in advance and be ready before the restrictions on bisphenols and other harmful substances are adopted and implemented:

1. **Adopt a chemicals policy** with quantifiable goals and timelines restricting bisphenols and other Substances of Concern from your products. Communicate your policy to your supplier as well as clients.
2. **Have your products certified** with ecolabels that restrict the use of bisphenols in textiles.
3. **Advocate for the Digital Product Passport to include Substances of Concern** while developing the criteria for the Delegated Acts for the textile industry with performance requirements as part of the newly adopted Ecodesign for Sustainable Products Regulation (ESPR) from 2024.
4. **To support governmental policy reforms** worldwide to advance ingredient transparency, eliminate bisphenols and toxic chemicals, and incentivize the development of green chemistry.
5. **For retailers to require from suppliers the disclosure** of substances of concern in the products.

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