HAZARDOUS SUBSTANCE REDUCTION POTENTIAL AT LOCAL BUSINESSES

EVALUATING RESULTS AND VERIFYING REDUCTION POTENTIAL BY SUBSTITUTION OF CHEMICAL PRODUCTS AND ARTICLES AT BUSINESSES IN THE BALTIC SEA REGION

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NONHAZCITY

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CONTENTS

1 INTRODUCTION

1.1 The NonHazCity project

The Interreg Baltic Sea Region Project NonHazCity ("Innovative management solutions for minimizing emissions of hazardous substances from urban areas in the Baltic Sea Region") aimed to demonstrate possibilities for municipalities, private households and businesses to reduce emissions of priority hazardous substances and other pollutants in urban areas that cannot be effectively controlled by traditional water treatment and enforcement techniques. In the course of the project, source-related behaviour change measures were proposed to reduce the emissions of hazardous substances in the urban system and eventually the Baltic Sea.

The NonHazCity consortium consisted of eighteen partners from nine municipalities and expert organisations in the Baltic Sea Region (BSR) that have taken responsibility to find new ways to reduce the emissions of hazardous substances from the large number of very small and scattered sources in their urban territories. The consortium was supported by a network of other associated organisations including municipalities, water utilities companies, national and international environmental authorities, and non-governmental organisations.

NonHazCity created new knowledge and evidence of hazardous substances in the wastewater and aquatic environments of the pilot municipalities as well as in indoor dust from private households, in inhabitants' bodies and in commonly used consumer goods (articles). Sources of hazardous substances were identified with help of the substance flow analysis method and conclusions published in a variety of reports (Giovanoulis, Lagerqvist & Arwidsson, 2018; Pettersson, Oldén & Lagerqvist, 2018; Gercken et al., 2018).

Based on evidence generated during the project, NonHazCity worked with three stakeholder groups - municipalities, businesses and private households - to set strategic chemical risk reduction goals (Chemical Action Plans) at the pilot municipalities. Chemical Action Plans defined substance reduction measures for municipal entities, businesses and inhabitants and tested their implementation. Information campaigns and training addressing the different stakeholders' groups were carried out (Lagerqvist et al., 2018).

One target group of the NonHazCity project was professional end users of products and articles potentially containing hazardous substances. Chemical risk prevention is becoming more important these days, but the fact that hazardous substances are routinely used in many businesses is still not common knowledge amongst either business owners or workers. Therefore, the project addressed different business sectors in the partner municipalities – independent of the size of the companies – to assess the chemical issues associated with their activities and to encourage them to engage in voluntary hazardous substance reduction actions.

This publication documents the common presence and potential for substitution of hazardous substances in products and articles routinely used in daily operations of businesses such as hairdressing salons, cleaning services, car repair shops, hotels and offices in general. Additionally, this publication systematized pilot actions for emission reductions within the project and gives best practice examples to empower other municipalities to support hazardous substance reduction activities in businesses in their territories

1.2 Hazardous substances

Hazardous substances are chemicals that are physical hazards (e.g., flammable/explosive) and/or harmful to the health of organisms and ecosystems. Restrictions on hazardous substances are set in national and EU chemicals legislation including REACH. Some substances are hazardous even at very low concentrations, e.g., the so-called endocrine disrupting compounds (EDCs) that affect hormone function. EDCs are a heterogeneous group of hazardous substances which might also exhibit carcinogenic, mutagenic and reprotoxic (CMR) properties. They disturb the hormone system of organisms, which might cause, e.g., an impairment of reproductive functions, developmental abnormalities, obesity and negatively affect the immune system. EDCs are not defined by their chemical structure or type of use, but rather by their mechanisms of actions leading to interference with the hormone system. Classification of EDCs is still evolving.

From the perspective of hazardous substance reduction potential, businesses were important for NonHazCity for three reasons: first, because of occupational exposure in the workplace, second because business activities may involve the use of hazardous substances that are later released into wastewater and the environment and third, articles or items produced or sold by businesses may contain hazardous substances.

Most hazardous chemical substances belong to one or more of the following groups:

- persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB);
- carcinogenic, mutagenic and toxic for reproduction (CMR);
- endocrine disrupting compounds.

Hazardous substances emissions can harm the environment

The cocktail of hazardous substances known to be present in sewage and surface waters reflects both private and business activities. As the chemical screening study performed in NonHazCity pilot municipalities clearly demonstrated, a wide range of hazardous substances is present in different types of waste water and in sludge from wastewater treatment plants (WWTP; Gercken et al., 2018).

Some of the hazardous substances investigated are persistent or pseudo-persistent and bio-accumulative and they may cause adverse biological effects when reaching a certain concentration in target tissues or organs. Moreover, a considerable number of readily degradable pollutants are present at relatively constant concentrations in natural waters. The fact that they are widely detectable is due to constant releases into the urban water cycle and incomplete elimination at wastewater treatment plants. In this way, these “pseudo-persistent substances” maintain concentration levels which may cause harm to aquatic organisms.

Overall, the collective burden of the multitude of diverse hazardous substances result in a cocktail or mixture effect on humans and other organisms and the risks are very difficult to predict. Exposure to hazardous substance combinations at low concentrations, the so-called “cocktail effect”, can lead to health problems that even though the individual chemicals are present at concentrations below thresholds regarded as “safe”.

Occupational exposure and emissions in workplaces

In some types of businesses occupational as well as customer exposure can be enormous. Hairdressers are one of the most exposed groups with this regard. What is more, users of cleaning chemicals such as cleaning services, hotels, catering and other industries also have a high risk of occupational exposure since hazardous components including acids or bases, disinfectant compounds, aggressive preservatives and fragrances are often present in cleaning products.

Other business sectors which might use products containing hazardous substances include car workshops, laundry services, building trades, the woodworking industry and healthcare services among others. Business activities in these sectors might pose both occupational/customer hazards and dangers of environmental exposure.

Being both source and pathway, businesses can reduce their hazardous substance footprint by substitution activities and good chemical management practices. Both emissions and exposure can be reduced as well as avoiding the passing of more hazardous substances down the supply chain. This can be done in many ways depending on the individual approach and practices of each business. Actions can range from application of personal protection measures, use of warning labels in workplaces to substitution or complete elimination of hazardous substances, thus moving towards greater occupational and client safety as well as decreased environmental exposure.

Legislation related to hazardous substances in workplaces

Small and medium size enterprises represent 99% of all businesses in the EU. Compliance with legal requirements with respect to chemical management might comprise a huge potential for hazardous substance emission reduction. Often, however, smaller businesses outside the chemical sector don't believe that they use hazardous substances in their operations while in fact; very few workplaces use no chemicals hazardous to health and/or the environment.

The majority of these businesses are users of chemical products downstream in the supply chain. For them, compliance with occupational safety and health (OSH) legislation is the prime lever for reduction

of hazardous substances in the workplace, since they are subject to European and national legislative frameworks. The main EU directives on safety and health at work are the OSH Framework Directive (89/391/EEC), the Chemical Agents Directive (CAD) (98/24/EC) and the Carcinogens and Mutagens Directive (CMD) (2004/37/EC) (see Annex 1 for more information on EU legislation with respect to chemicals). These EU directives are supplemented by other OSH directives on binding and indicative occupational exposure limit values (overview at: https://osha.europa.eu/en/safety-and-health-legislation)

As European legislation often lays down only general provisions, EU member states are entitled to implement more detailed and strict regulations for the protection of personnel at work. Hence, it is recommended to consult specific national OSH legislation in order to gain insight into actual protection measures.

Substitution of hazardous substances or mixtures by safer alternatives is demanded and regulated at the EU level by the long-standing principle of "replacing the dangerous by non-dangerous or less dangerous" (OSH Framework Directive 89/391/EEC). The newer REACH Regulation supports this goal by encouraging manufacturers to substitute hazardous substances in their products. However, in practice it is often ignored or claimed to be infeasible. Enterprises often prefer to invest in, e.g., personal protection equipment instead of substituting chemicals or products (additional information about the substitution process is given in Annex 2).

2 THE NONHAZCITY ACTIVITIES WITH BUSINESSES

2.1 Methods used to approach and contact businesses

The NonHazCity activities started from simple steps. First of all, the most important stakeholders were targeted, in most cases these were business associations, professional associations and educational institutions. The project team aimed not only to educate companies on hazardous substances but also to inspire them to action and identify possible change agents outside and inside their organizations.

"Stockholm municipality has had a Chemical Center since 2014. The seven employees are dedicated to helping the city, businesses and residents achieve the vision of a non-toxic city as outlined in the Stockholm Chemical Action Plan. The center works on chemical aspects of public procurement, safe handling of chemical products and information for companies and consumers. More information": http://www.stockholm.se/PageFiles/1176228/engmar16webb.pdf

The cooperation between municipalities and businesses differed among the project partners:

- Project experts from the Baltic Environmental Forum in Estonia, Latvia and Lithuania acted as consultants. They approached companies as municipal staff had neither extensive specific experience nor a history of cooperation with small businesses operating in their territory, at least not on environmental health and pollution prevention issues.
- In Stockholm, the Chemical Center cooperates extensively with different business stakeholders and has a longer tradition of this type of contacts
- Turku city has an established strategy concerning market dialogues with business, e.g. on public procurement issues
- Hamburg facilitates a business partnership forum on environmental issues ("Umweltpartnerschaft") where the NonHazCity team could find interested businesses for assessment and cooperation.

Stakeholder mapping

The NonHazCity team mapped business stakeholders in the partner cities to narrow down the target groups and to find entry points for communication. The main idea was to identify the most relevant businesses in the municipalities based on their chemical use profiles but also to find out about specific local conditions or companies with a strong local identity.

Municipal databases, existing data on chemical pollution from national inspections and monitoring were all used to identify target groups. Another source for stakeholder identification were the local environmental and development plans in which business sectors are addressed as well as awards or clubs related to the environmental performance of businesses.

The following business sectors were identified as priority target groups: car repair & washing facilities, laundries and dry cleaners, cleaning and property management services, hair and beauty salons, swimming pools and spas, hotels, restaurants and food services, child & elderly care facilities, recreational facilities (e.g. marinas & boat clubs) and hospitals. These sectors are end users of numerous chemical products and articles and are often particularly poorly informed about workplace chemical risks. Thus, the potential for both hazardous substance reduction and OSH improvement are high. The building trades and construction materials sectors were also targeted with mixed success, depending on the level of prior environmental awareness (exceptional case: the Hyvinkää construction of an ecolabel led Day care, see Chapter 2.3.4).

The NonHazCity teams identified potential multipliers of the project information including business associations and sectoral training and education facilities. The team also liaised with potential multipliers on their regular programmes.

Ways to approach businesses

NonHazCity put a lot of emphasis on how to approach businesses and motivate them to implement concrete chemical reduction measures. Especially those sectors which are less aware that chemicals risk management actually is issue for them were paid attention. The project team used a variety of approaches (see Table 1) to convince businesses to pay more attention to responsible management of hazardous substances.

In the first communication with individual businesses, the NonHazCity team introduced the project and highlighted that the municipality intends to encourage voluntary cooperation with certain business sectors. The team also provided some background about why the problem of hazardous substances in professional products is relevant and what can be offered in mutually beneficial cooperation. Information days and training courses were organised for business representatives where chemical issues were addressed – for example hazardous substance occurrence in products, articles and their use in everyday business operations as well as occupational health and safety issues. Actions that businesses could take at their own facilities were also identified.

Approaches used in the partner municipalities to facilitate hazardous substance reduction by businesses	Promoting interested businesses through various municipal visibility tools, such as newspapers, web platforms, social media, etc.
	Offering visible acknowledgement to the businesses that agreed to reduce the amount of some hazardous
	Organising trainings/seminars/info days
	Information material: specific branch related publications on hazardous substance reduction

Table 1: Measures used in partner municipalities to support hazardous substance reductions by businesses

NonHazCity developed a set of different information materials to assist in chemical risk management for specific business sectors including:

- Hairdressers and beauty salons (in English, Lithuanian, Finnish, German, Swedish, Estonian)
- Hotels and accommodation facilities (in German, Polish, English)
- Offices in general (in German, Polish)
- Marinas, boat clubs and shops selling antifouling paint for boats (in Swedish)
- Private (and public) childcare facilities (in Swedish, Estonian)

Commitment and involvement

The NonHazCity team searched for a few pilot businesses in the partner municipalities to implement concrete hazardous substance reduction measures. After general communication and advertisement activities a few of the most interested companies were visited by the project team and cooperation projects designed. Companies participating in NonHazCity were asked to sign informal partnership agreements which in most cases helped to keep the projects running. In exchange for their readiness to cooperate, companies received competent advice and consultancy from the NonHazCity experts

Organisational learning

In a first step, the chemical products used in day to day operations were screened on the basis of in-depth chemical inventories and by checking the available safety data sheets. Afterwards, the NonHazCity team discussed priorities for substitution with company management and helped them to search for alternative products.

The evaluation of possible alternatives was done in cooperation with the company, as they are better informed about market availability of alternatives to the currently used products, and if substitution would fit the technical and economic needs of the business. Most importantly, the proposed alternatives were carefully checked by the NonHazCity team to confirm that their use would not have more hazardous effects. This step is important in order to avoid “regrettable substitution” (when a product or material believed to be less hazardous turns out to have unexpected additional hazards).

Endorsement and dissemination

Public endorsement for those businesses who substitute with safer alternatives is important as it provides recognition for their efforts and encourages them to do more. Public endorsement of environmentally aware companies will also encourage others to follow. Companies participating in NonHazCity did not get awards directly related to better chemical management, however, partner municipalities were advised to include a category in any responsible/environmental business awards, related to hazardous substance reduction and substitution activities.

2.2 Sectors in focus

Hairdressers and beauty salons

In the EU the hairdressing sector employs more than one million people who work across about 400.000 to 500.000 hairdressing salons. The majority of hairdressing salons are small establishments with, on average, less than three employees (EU OSHA, 2014). According to the European Agency for Safety and Health at work (OSHA) hairdressers are exposed to serious occupational health risks which set the improvement of working conditions as a major priority. Typical health complaints include irritant and allergic contact eczemas, sensitisation and allergies occurring due to chemical components present in products. Furthermore, a significant number of hairdressers leave the profession early due to health problems such as allergies, dermatitis or other conditions

Hazardous substances and beauty products

- Many hair dyes and colours contain hazardous substances: coal tar, formaldehyde, phthalates, parabens, ammonia and DMDM hydantoin. Other common ingredients are para-phenylene diamine (PPD), 2,5-Toluendiamine (PTD), p-aminophenol and resorcinol. Dark permanent dyes are the most dangerous because they cause chemical changes in the hair shaft.
- Permanent waves: Perms often involve the use of glyceryl thioglycolate ester which can lead to serious skin disorders (sensitization).

Some beauty products can cause respiratory harm via airborne pathways. This is no surprise, since a great variety of volatile chemicals and synthetic fragrances are used in hairdressers' daily work. Use of hair dyes, permanent wave or straightening solutions and bleaching agents can all result in exposure to hazardous substances via inhalation, skin and eye contact and ingestion. Thus, all types of personal protective equipment should be considered to minimize exposure (EU OSHA, 2014). Furthermore, hairdressers are more affected than other professions with regard to cancers (e.g. bladder cancer) and reproductive disorders. Customers may also suffer from health problems caused by "salon chemicals" such as skin penetrating hair-dye ingredient toluene-2,5-diamine, which have been detected in urine after hair colour treatment (Schettgen, 2010).

Due to the huge amount of hairdressing and cosmetic products the number of problematic ingredients is rather comprehensive as will be well illustrated by the cases below. Annex 3 presents a list of such chemicals.

Cleaning services and other users of cleaning products

Like the hairdressing and beauty sector, the cleaning sector constitutes one of the most important service providers. In 2006, about 3.6 million workers were contracted in 129,000 European companies. The sector mainly comprised small and micro businesses, with 9/10 companies having less than 50 employees. The sector engages in a wide range of cleaning tasks in e.g. offices, pre-schools, schools, hotels, hospitals and health care providers as well as providing industrial cleaning services (EU-OSHA, 2009). Contract cleaning has grown steadily over the recent decades. Overall, an estimated 7.3 billion euros were spent in 2017 on professional cleaning and hygiene products within the EU.

Employees of professional cleaning services are occupationally exposed to a multitude of hazardous substances in specialized cleaning and hygiene products. There is a considerable congruence of hazardous substances present in products used in the hairdresser/cosmetic sector and the cleaning sector, e.g. chemical groups like surfactants, preservatives or fragrances are likely similar and occupational problems are not uncommon. Studies have shown that respiratory diseases including asthma and skin diseases like dermatitis are common amongst people working in this sector.

A more accurate scientific estimation of the occupational exposure to cleaning products on an EU level is hampered by the large number of chemicals present in the multitude of products used (Gerster et al., 2014). One Swiss study investigated the hazardous properties of professional cleaning products through a systematic analysis of safety data sheets (SDS) of these products. In 105 selected products, 132 different chemicals were identified (Gerster et al., 2014). Some of the most frequently detected hazardous substances included glycol ethers, ethanolamines and polyoxyethylenes while fragrances were observed in 27% of the professional cleaning products (Gerster et al, 2014).

Furthermore, negative environmental effects are also likely (Ebele et al., 2017) since products used for cleaning purposes end up in waste water following correct use. In a simplified view, from there the hazardous substances in cleaning products may enter the aquatic environment and affect ecosystems in different ways, e.g. exert toxic effects, accumulate in biota and spread through food webs. Chemicals present in personal care and cleaning products have been found in the Baltic Sea aquatic environment (HELCOM, 2009).

Car repair shops

Like beauty salons, car repair businesses are often small or micro enterprises with one or a few employees but their total number in a municipality or region can be rather substantial. Car repair businesses deal with a wide variety of products used for the repair and maintenance of vehicles. Isocyanates are one example of hazardous substances used in car repair businesses. These chemicals serve as glues, lacquer hardeners, adhesives, fillers and sealants as well as coating and insulation materials. Spray-painting is an application with a particular high exposure risk. Other examples of hazardous substances include asbestos dust derived from brake pads, benzene, toluene and xylene present in solvents and antiknock agents. Workers at car repair shops use products containing chemicals that pose the risk of serious health effects including petroleum-based solvents, paints and rust dissolvers as well as primers, polishes and fillers.

Overall, car repair workers may develop grave health effects, mainly via breathing fumes and direct dermal contact if the exposure is continuous. Hence, respiratory and dermal disorders and allergies are the most frequent occupational diseases. Proper risk assessment and chemical management is of great importance in this type of business. Necessary protection measures should focus on the reduction and substitution of dangerous products.

Hotels and offices

Hotels and offices are premises where the exposure of employees and guests to hazardous substances is not obvious at a first glance. However, large quantities of cleaning and disinfectant products which likely contain hazardous substances are regularly used in offices, hotel rooms, conference rooms, kitchens, restaurants and laundry facilities. Large quantities of personal care and hygiene products from guest rooms and sanitary facilities are used in hotels which are washed away into the wastewater stream via showers and sinks.

Another more hidden health hazard in hotels, offices and other facilities is pollution of the indoor environment which may originate from articles, materials and consumer products containing hazardous substances. Since workers and staff usually spend most of their working hours in indoors, the indoor pollution load is a relevant factor concerning public health and in recent years there has been greater scientific and public awareness about the effects of indoor environment quality on health and well-being.

Articles and materials which may reduce the quality of the indoor environment include furniture, textiles, electronics, flooring and wall covering. All of these products may contain hazardous substances that can migrate, abrade or off-gas, resulting in human exposure through air, dust or dermal pathways. Hazardous substances commonly found in the indoor environment are phthalates, flame retardants, synthetic fragrances and highly fluorinated substances (PFASs) which can have adverse effects on health and environment (Mitro et al., 2016). Wall paints may contain a variety of hazardous substances including plasticizers, alkylphenol ethoxylates, organohalogenated compounds, azo dyes, isothiazolinones and formaldehyde. Coloured wallpaper may contain acetone, toluene, 1,2-propanediol, 2-butoxyethanol, hexanol and formaldehyde.

Furthermore, office supplies can contain a variety of contact allergens including dyes and heavy metals. In addition to allergic reactions and irritations, headaches and lack of concentration often come as a side effect, when people are exposed to unhealthy emission of chemicals. Emission sources of hazardous substances include office supplies, e.g., correction fluid, permanent markers, adhesives, glue sticks, ink pads and chlorine bleached paper. Permanent markers may contain partly aromatic hydrocarbons (toluene, xylene), which can have a toxic effect on our nervous system and can promote cancer. Solvent-free, low-emission products should be used whenever possible. In addition, contact allergens from nickel-containing objects (paper clips, scissors), adhesives (formaldehyde), pens (azo dyes, dichromate), plastic objects (formaldehyde), and inks (dichromate, cobalt, Gentian Violet V, aniline, lanolin) can occur.

Other sectors

Except for the sectors in focus there are other important companies that could perform substitution to decrease emissions and exposure of hazardous substances. The construction sector is one of them – with large business operations in town and huge reduction potential. Also, trade companies sell products and articles, bought by inhabitants and professional users. Other examples of companies are car washing facilities, laundries and dry cleaners, cleaning and property management services, beauty salons, swimming pools and spas, restaurants and food services, child and elderly care facilities, recreational facilities and hospitals, which all can make choices to decrease the use and emission of hazardous substances.

2.3 Findings from the visits to selected businesses

Hairdressers and beauty salons

At one consultancy visit to a hairdressing salon in Turku the screening of about 60 hairdressing products including shampoos, conditioners, sprays and hair dyes revealed a widespread occurrence of problematic ingredients. In total, 56 hazardous substances were identified, with between 1 and 10 hazardous substances per product. Annex 4 presents a list of the most frequently found hazardous substances in hairdressing products from the Turku salon.

Less is more

- Following consultation by NonHazCity partners the number of products used by a Turku hairdresser was reduced by almost 50%.
- The number of hairdressing products can be reduced without negative effects on the scope of services offered by a salon.

As a result of the consultation a number of hairdressing products containing hazardous substances are no longer used at the Turku salon. However, for other products alternatives still need to be proposed. In these cases, substitution was often difficult or impossible, mainly due to the lack of eco-labelled professional hairdressing products.

More hair and beauty salons were consulted in Lithuania: two in Kaunas and one in Šilalė. Chemical inventories were made, and ingredients were ranked according to their degree of hazard for each product or product group. In addition, recommendations on how to avoid hazardous substances were provided. However, it was difficult to suggest alternative human health and environmentally friendly professional beauty products since they were not readily available and easily discoverable in the Lithuanian market.

Some positive results of the consulting with hair and beauty salons include attendance at seminars and workshops about hazardous substances and the new knowledge about workplace safety and which chemicals to avoid.

The Nose Knows

Another very problematic substance class found in many products is typically labelled as “fragrance”, “perfume” or “aroma”. An individual fragrance in a product is usually a mixture of several tens to hundreds of chemicals, primarily synthetic substances. As fragrances are treated as a trade secret, the full ingredients do not have to be listed on the product label. The potential health effects of fragrance mixes are manifold. Some may contain endocrine-disrupting substances (e.g. phthalates), others have been associated with allergies, dermatitis, respiratory distress, neurologic problems and reprotoxic effects. Moreover, fragrances are a primary source of indoor air pollution.

In Hamburg, NonHazCity partners did a survey on hairdressers and their eco-efforts. Surprisingly, no eco-certification was in use and none of the 1750 listed hairdressers participated in the „Green Salon“ programme or in any other programme working with blacklists of hazardous substances as a criterion. Only three hairdressers in Hamburg explicitly label themselves as „eco-hairdressers“. They try to use eco-labelled products as far as they deem it possible. At the same time, they stress the fact that not every hairdressing service can be offered in an eco-variant as certain colours, dyes or styling products are simply not available.

At the City of Stockholm, action has been taken to raise awareness among owners and employees of hairdressing salons about hazardous ingredients in their daily work products and how to reduce or avoid health risks. A brochure, “Chemical Smart Hairdresser”, was produced and distributed (see project website).

Challenges for reducing hazardous substances at hair salons:

- There have to be more eco-friendly hairdressing products on the markets to offer businesses a wider range of purchasing choices.
- Increased knowledge amongst employees and customers will increase the demand more healthy and environmentally friendly products.
- Improve professional competence to distinguish trustworthy eco-products from greenwashed products.

From the work with hairdressers it became clear that many of the hazardous substances identified are toxic to the aquatic environment. In Sweden alone in 2011 about 830 tons of hair dyes (equivalent to almost 90 g / person) were released to sewers from hairdressing salons. It can be assumed that a similar per capita pattern of emissions exists in other countries.

During the product inventories performed in hairdressing salons it became apparent that hair dyes are especially problematic with respect to hazardous substances. Most often hair dyes contained para-phenylenediamine (PPD), para-aminophenol, ethanolamine, toluene-2,5-diamine and resorcinol. All these substances are skin sensitizing, and some have strong allergic potential. Moreover, harm to the immune and hormone system are also quite common health risks.

To summarise the findings from the NonHazCity work with hairdressers, there is a strong demand to reduce or eliminate toxic chemicals in salon products. Taking into account the huge number of hairdressing salons in the Baltic Sea Region, the reduction potential for hazardous substance is estimated to be substantial.

Cleaning services and other users of cleaning products

A business providing professional cleaning services was consulted in Pärnu. An inventory of the detergents in use was performed and harmful ingredients identified by checking the safety data sheets. The amount of detergents used per year was rather low because of the small size of the company. Based on annual consumption in 2017 and information from the safety data sheets, the potential reduction of hazardous substances from detergents was calculated. The replacement of 5kg toilet refresher used would lead to a reduction of 0,5–1,25kg benzenesulfonic acid, C10-13-alkyl derivs., sodium salts and 0,125–0,5kg sodium p-cumenesulphonate. The annually use of 84l of lavatory cleaner released up to 2,1 litres of 2,2'-(octadec-9-enylimino) bisethanol (PEG-2 oleamine) to the environment. The substances identified in the detergents are harmful if swallowed, cause serious eye damage and skin irritation and are harmful to aquatic life with long lasting effects.

Despite the wish of the business to become an eco-friendly service provider, this was not viable since the share of alternative eco-labelled products was low. However, the company strives towards an environmentally friendly direction and is adapting alternative eco-friendly products. In fact, immediately after the inventory was done, hazardous toilet and air refresher products were phased-out.

Another professional cleaning service was approached in Turku. The inventory done at their premises comprised 37 products of which 12 were suggested for replacement. Six products were top priority due to hazards of skin and eye damage, adverse respiratory effects and acute or chronic aquatic toxicity. The company intends to replace these hazardous products in the future.

A Finnish professional cleaning company with branches in the Baltic countries has replaced some chemical cleaning products by the use of ultrapure water and microfiber cloth which are effective in cleaning e.g. glass and stainless-steel surfaces. For other tasks eco-labelled products are used. The company makes a strong effort to train staff concerning correct dosage of chemical products, in order to minimise their use, thereby saving money and protecting the environment.

The inventories performed in Kaunas and Šilalė district at an elderly-care facility and rural tourism accommodation focused on personal care and hygiene products as well as cleaning products in use. Disinfectant products, shampoos and air freshener were common at the elderly care facility while all-purpose cleaners were more common at the latter two businesses.

Hazardous substances and cleaning services

- Disinfectants: typical ingredients are active substances (aldehydes, alcohols, quaternary ammonium compounds, "active chlorine" ingredients, alkylamines, etc.), solvents, surfactants, perfumes.
- A substantial share of hazardous cleaning products might be replaced by less toxic products based on alcohols or ultrapure water .

One checked disinfectant contained quaternary ammonium compounds as biocidal agents. This group of compounds are toxic to health and harmful for aquatic life it was recommended to substitute their use with alcohol-based disinfectants. The substitution of the 12 litres of product used annually would result in an estimated reduction of 44g of quaternary ammonium compounds.

Other prominent hazardous chemicals identified were isothiazolinones (e.g. methyl-, benzisothiazolinone) present in shampoo, shower gel, bathroom cleaner and dishwashing liquid. The percentages of these chemicals in products ranged from 0.0004 to 0.007%. These percentages might be considered as rather low, but methylisothiazolinone is known to be a potent allergen. Even though the concentrations are small, taking into account the widespread use of these antimicrobial biocides, their emission to the environment might be considerable.

Following the inventory of cleaning products at the elderly-care facility a list of available products with fewer problematic ingredients was presented to the management. It was suspected that some inhabitants' allergies might be related to the use of scented personal care products as many fragrances have allergenic properties.

Car repair shops

A product inventory was performed at a car repair/demolition business in Turku. Two products containing hazardous ingredients were identified, a rust dissolver spray and a welding spray. The rust spray contained 70 – 90% hydrocarbons (C9 - C10, n-alkanes, isoalkanes, cycloalkanes, <2% aromatics) and 10 – 20% hydro-treated light paraffinic petroleum distillates and 7.5 kg of the product was used annually. The NonHazCity team recommended the use of an alternative rust spray based on ethanol (30-50%) containing less harmful ingredients (6.7 kg/year).

The welding spray contained a mixture of chemicals with toxic, health damaging and aquatic toxicity properties. The alternative recommended to the business was classified as non-toxic and biodegradable.

Centralized chemical products suppliers help businesses to manage chemicals

- A chemical inventory was performed at Oili Jalonen Ltd., a 24/7 car breakdown and recovery service in Turku, Finland that recycles cars and sells new and used automotive spare parts to consumers and businesses. ~40 chemical products were identified and 10 were suggested for substitution. Oili Jalonen Ltd. decided to test two replacement products: rust remover and anti-spatter fluid.
- Centralized chemical products purchase can help to reduce the total amount of products in such car recovery companies' inventory from 100 to 30. However, all chemical product suppliers do not necessarily know the chemical content of the products they are using.

In Gdańsk, NonHazCity established contact with a company running petrol stations with car washes throughout Poland. Safety data sheets were obtained and hazardous substances in their inventory of products included: 1-propanaminium and 2-hydroxy-N-(2-hydroxypropyl)-N,N-dimethyl-, monoesters with fatty acids, C18 unsaturated, methyl sulfates. These substances may cause eye damage and skin irritation and they also show chronic aquatic toxicity properties. The company was informed about the harmful properties of their products and more consultation was planned. Unfortunately, following a change of the management the business no longer had an interest in continuing consultation by NonHazCity.

Hotels and offices

There were several consultations performed with hotels. NonHazCity partner teams carried out interviews, based on specific questionnaires designed for hotels, during project events which were also located at the specific hotel. Interviews took place in Poland, Germany, Denmark and Latvia. The interview questions covered issues such as environmental certifications, ecological cleaning, cosmetics and furnishings.

Most hotel environmental management systems focus on energy, waste and water management, not on chemicals management. Often hotel employees lack the time or the knowledge to search for alternative products. The same is true of the various certification programs. However, many certification programs offer the possibility to support the implementation of environmental measures. But care should be taken to use third party certification whenever possible. Self-certification can be perceived as "green washing" if no independent auditor is checking both the certification criteria and their implementation. One example third party certification is The Green Key label which means an independent auditor has certified the hotel in a similar manner to an EU Eco-Management and Audit Scheme (EMAS) audit for other businesses.

During the NonHazCity project, partner meetings and international events were often held in conference facilities of hotels. Therefore, the partners decided to check at the hotels where project meetings were

held, do interviews and talk to the management. At several Green Key certified hotels, it became clear that not all chemicals criteria are implemented at once and there is a lot of room for improvement. The certificates are new in Baltic States and Poland and staff does not yet have much experience in implementing them. But we found some inconsistencies also in the same hotel chain in Denmark. The main criticism we had included: no organic soaps in guest rooms, strong fragrances in the toilets and in the public spaces and still single-use plastic packaging during coffee break arrangements – but the hotel management in all cases was open to advise and eager to make improvements.

BEF Germany carried out several office checks at volunteer companies. To their great surprise disinfectants were used widely and in large quantities – they were found in each bathroom and kitchen at the different offices. Furthermore, it became obvious that management of the companies have no time and not enough knowledge to consistently implement environmentally friendly procurement rules, they were not part of a strategy. Nevertheless, some office materials such as pens, markers and paper were identified with eco-label, some of them refillable; also, some furniture were found from natural materials – wood. One of the larger potential sources for exposure of the employees to hazardous substances was the flooring material at all offices visited, mostly carpets from synthetic materials and often fixed with glue.

The INTERREG's office check

An inventory was performed at the INTERREG office in Rostock, Germany, by the German NonHazCity expert team to apply the project criteria also at the donor's facility. The visit aimed to check the office facility – two floors of an office building with individual offices, meeting rooms, kitchen and bathrooms: interior materials and furniture, cleaning services and office utensils were checked and discussed with the management.

Most of the interior materials and furniture were identified as environmentally friendly; however, the NonHazCity team recommended several articles to be checked with their providers. Hints on office material improvement were given. It turned out that the procurement for office materials was not undertaken by the secretariat itself, but by the mother company, the Investment Bank of Schleswig Holstein and their environmental procurement strategy needs to be checked.

The visit was timely - the JS was planning to announce a tender for a cleaning service. Advice on defining specific criteria for cleaning agents referring to hazard criteria was provided. The main message of the NonHazCity team was to be explicit with regard to hazard criteria and not too generic. The advice was implemented in the tender for a new cleaning service.

Other businesses visited

A consultation on chemical safety issues and a chemical inventory was made at a general construction and concrete works company located in Pärnu. The products in use, mainly paints and solvents, were checked for hazardous properties (CMR chemicals) or environmental toxicity. Fortunately, no substances or products needing substitution were identified. The enterprise uses environmentally friendly paints from a Finnish company which has a Green Business Certification, hence, there was no reason to give advice for product substitution. Overall, advice how to update the chemicals inventory was considered useful and the company updated their system with information on the content of mixtures and their hazard classification. An inventory check performed at a Pärnu company producing fishing lures led to similar results. The SDS check identified no substances of concern. The advices regarding workplace safety and chemicals inventory were considered very useful by the business.

2.4 Potential for reduction of hazardous substances at sectors in focus

Hairdressers

The descriptions of business visits and chemicals inventories in the previous paragraphs give an insight into the frequent use of products containing hazardous ingredients in workplaces. Contact with hairdressers showed that there is a high potential for reduction or substitution of chemicals in this business sector as there are between 400.000 and 500.000 hairdressing salons in the European Union which together have about 1 million employees (European Cosmetic Industry, 2018).

Oxidative hair dyes are both the most toxic group of hair dyes and constitute the majority of hair dyes applied. An estimate was made of the world-wide production of oxidative hair dyes in 2005, by the international hair dye industry. The data show that some of the particularly toxic ingredients were used in rather high production volumes. Examples of these ingredients are:

- resorcinol 200-250 tonnes,
- para-phenylenediamine 150-200 tonnes,
- meta- and para-aminophenol each 50-100 tonnes
- 2-m ethyl-5-hydroxyethylaminophenol 50-100 tonnes.

Out of the other 50 compiled ingredients, some were used in the range of 10-15 tons and more often 1-5 tons (IARC, 2010).

Denmark is a frontrunner for “green hairdressing”. Chemical substances are one of the areas for action included in the concept; no hair products shall be used by Green Salons which are listed in the Green Salon prohibition list. Furthermore, all cleaning must be carried out with eco-labelled cleaning products. Meanwhile, the concept of Green Salons has spread to Sweden and Norway as well. It is expected that in the medium term the share of environmentally friendly hair and beauty products in the market will increase in order to meet the demand.

In 2016 a “Declaration of the European Social Partners on Health and Safety in the Hairdressing Sector” was signed, which emphasises the demand to substitute products containing hazardous ingredients when possible.

Cleaning services

Like the hairdressing and beauty sector, the cleaning sector constitutes one of the most important service providers in the European Union. In 2006 about 3.6 million workers were contracted in 129,000 companies. At that time, the sector mainly comprised small and micro businesses. About 89% of the companies had less than 50 employees. This sector executes a broad variety of tasks e.g. cleaning in offices, schools, pre-schools, hospitals, other health care providers and industries (EU-OSHA, 2009). As a consequence of the outsourcing of contracts, the cleaning service sector has grown steadily over the recent decades. Overall, an estimated 7.3 billion Euros were spent on professional cleaning and hygiene products in 2017. These numbers indicate the potential for hazardous substance reduction and substitution measures within this sector.

Cleaning service employees may be exposed to a broad range of hazardous chemicals. Exposure may occur from using cleaning products with hazardous ingredients, on by contact with contaminated dust, dirt and indoor air at the premises.

For businesses, the substitution of hazardous products by more eco-friendly ones is not really laborious since products with a trustworthy third-party ecolabel can be purchased in ever-growing numbers. Such products are usually no more costly than comparable non-certified products. Besides, price is no longer the primary criterion, as social and environmental aspects, are increasingly becoming important. For example, about 5,300 eco-labelled consumer cleaning products, including detergents, were registered across the EU in 2017.

Overall, methodological approaches and a sufficient choice of certified eco-labelled products are available to serve different cleaning demands. In combination with system to ensure proper dosage of chemical products, the prerequisites exist to reduce emissions of hazardous substances to the environment.

Altogether, the reduction potential for hazardous substances used in the cleaning sector is considerable. For example, in Sweden alone an estimated 50.000 tons of cleaning products (or 5.3 kg / person) are used every year. Even though hazardous ingredients may only be present in low percentages, any significant reduction in the non-environmentally friendly cleaning products across the Baltic Sea Region would result in a considerable drop in emissions of hazardous substances to the Baltic.

Other sectors

Quantification of substitution potential is not possible for articles and materials including indoor decorations, clothes, furniture, flooring materials, textiles and plastics. The reason for this is that identification of hazardous substance content in articles and materials is challenging, as they require neither a safety data sheet stating the contents, nor a full material disclosure.

A small trial for quantifying the substance reduction potential of articles was made in Stockholm, which has both municipal and private preschools (Lagerqvist, 2018). The chemical content of old and new resting mattresses and plastic toys used in the preschools were quantified using laboratory analyses. Calculations were made based on the laboratory results together with statistics for removal of old items and replacement with new articles at the preschools. Old items contained much more hazardous substances than new ones and the efforts made to reduce the amount of hazardous substances present in the everyday environment of children in preschools was effective since several tonnes of hazardous substances were removed when old items and articles were replaced with new ones. From this example, it can be concluded that the reduction potential of hazardous substances in similar articles and materials is potentially significant.

In the city of Hyvinkää, Finland, a Nordic Swan eco-labelled preschool has been designed, procured and built. The construction company that won the tender took into account the criteria set by the Nordic Swan Ecolabel for example for phthalates and formaldehyde emissions (as well as energy efficiency criteria and other environmental targets). The companies participating to tender calculated that the eco-labelled preschool would cost ca. 25% more in comparison to a traditional preschool, however, the companies found the project so appealing that the procurement costs were not higher for the client, not even indirectly. The construction company also reported more time investment into the preparatory phase due to the need to check for materials and find new suppliers. However, these time investments were due to the novelty of the construction task and will diminish when eco-labelled buildings become a standard product (Kontturi et al., 2018).

3 BEHAVIOUR OF THE BUSINESS FACING THE CHALLENGE OF CHEMICAL RISK MANAGEMENT

Business practices are changing to accommodate environmental requirements. For some, the new requirements are an opportunity and new restrictions can be seen as a cause to create new market niches. Unfortunately, many companies have limited knowledge and information about the actual hazards of substances used or their impact on the environment, especially if they are users of products and articles later in the supply chain. It can be thought that if this lack of knowledge and information is so widespread then perhaps the existing regulatory mechanisms are not sufficiently enforced, and market incentives are not yet powerful enough. Whatever the reason for this knowledge gap, it translates to an opportunity for capacity building on chemical risk management issues and it is an important driver for societal change.

3.1 Knowledge and awareness assessment from a business survey

A survey conducted by the project partner BEF Latvia in cooperation with the BA School of Business and Finance in Riga, Latvia aimed to investigate the level of knowledge typical representatives of businesses had about chemical management. The survey was also designed to elicit their views on the value of external guidance or assistance to help improve internal chemical management. The survey targeted two types of businesses: producers/manufacturers of goods (companies that are likely to use chemicals in their production processes either as raw materials or as auxiliaries) and all other companies and service providers who are likely to use chemicals in their daily operations, but who are not primarily producers/manufacturers (e.g. various companies in office buildings, hairdressers and beauty salons, restaurants, educational institutions, etc.). In total, 139 companies participated in the survey.

Business knowledge and awareness of hazardous substances

- Majority of businesses are concerned that the information given to consultants will be divulged to third parties, like controlling authorities, even if data confidentiality is promised;
- They assume that alternatives, if there would be a need for them, cost much more, potentially putting the company in a disadvantageous position;
- Most of small enterprises operate in so called “grey” zone (some companies) – perhaps do not fulfill all legal obligations, do not pay all taxes, etc. These companies always want to maintain as low profile as possible outside their respective business niche, not to draw specific attention to them.

From the NonHazCity project partners’ experience and this survey it might be concluded that the general awareness of the business sector about chemical safety, cleaner production and safer product choices is rising. However, there is still definitely room for improvement – as reflected by the needs revealed by contacts with these companies. Businesses are willing to get new information and participate in training activities in order to improve their knowledge and skills. More direct approaches for co-operation, such as voluntary agreements, direct consultancy, etc. face resistance from the target group, as reflected by their reluctance to participate in funding and innovation schemes as well as in projects involving chemical consultation such as NonHazCity. The reasons, indicated by businesses, are various.

3.2 Supply chain communication

The European REACH Regulation establishes a duty to communicate information on substances in articles. REACH Art. 33(1) specifies any supplier of an article containing a so-called substance of very high concern (SVHC) above a certain threshold value shall provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance. The information is to be provided to a private consumer upon request and for a professional customer, at the delivery of the goods, pursuant to REACH Art. 33(2).

According to ECHA’s 2016 report on the operation of REACH, there are “clear indications that information on substances in articles is not adequately communicated in the article supply chains”. This may be due to several reasons, such as a lack of awareness of companies on their obligations to communicate on SVHC under REACH and the fact that article supply chains are complex and involve a high number of duty holders. If one actor in the chain fails to communicate, all subsequent actors are unable to fulfil their requirements, unless they conduct chemical analyses to measure the SVHC content. Companies appear not to acknowledge the benefits of knowing the SVHC content in their articles and hence lack incentives

for communication – especially if they are far down the supply chain and they are not responsible for production of the article.

Nevertheless, increasing societal demands and expectations directed at transparency about substances in articles and the overall "sustainability" of supply chain operations put a strong demand for business to change.

The City of Stockholm conducted between years 2016-2018 11 seminars for trade companies as part of the NonHazCity project. Knowledge in this group is generally very low but some, often large, companies work systematically with substitution of hazardous substances, are well aware of REACH and other legislation and some even want to do more than legislation requires, although just to fulfil regulative requirements is demanding. Trading companies are open to get new information about chemical issues, and they seem open to communicate their work to other companies. As they seldom produce the things they sell, they have an opportunity to choose what to sell and make requirements on suppliers. However, it is difficult to know the content as that information is not following automatically. Supply chain communication is the key, and support in what materials and/or substances to prioritize for substitution is needed. A questionnaire performed showed that 22% had started to put demands and started asking questions to their suppliers, as a result of attending the project seminars.

3.3 Drivers for change and motivation

For smaller enterprises, one of the drivers for change is increased awareness when the management of the company realises the importance of chemicals issues - including substances in products, their constituents and their relations to possible health and environmental effects. What is more, realising that legislation applies to them as well, can be surprisingly motivating. Sadly, sometimes negative experiences are a driver, e.g. occupational incidents or occurrence of occupational diseases that force businesses to change their practices or products as is common in the hairdressing sector.

Other drivers include media highlighting specific chemical issues and customer demands that cause company management to reconsider and shape their organisations' image for the better by reducing hazardous substance use and becoming first or among very few to offer hazardous substance free products or services.

In businesses, the change management strategy differs depending on type of the organisation and scale of the change. Minor changes such as substitution of the products at hair salons might be quick and effective, while some changes require technological preparation and substantial financial investments. Thus, it is advised that each organisation develop their own scheme for hazardous substance reduction and substitution.

The first steps in hazardous substance reduction are for a business to learn about hazardous substances, to make an inventory of chemicals used and identify products containing hazardous substances.

Awareness of chemical issues can be raised by organizing seminars for businesses, as was done in the NonHazCity partner municipalities. The arguments for change that a business might use differ depending on the type and scale of the company. The change itself may vary from changing products to innovations in technology. One more argument that should encourage companies to change is the EU Circular Economy Strategy where huge attention is paid to chemicals in articles that end up as waste.

Challenges to adaptation by businesses might include responsible behaviour, personal characteristics related to values, competencies and actions of owners or managers as well as economic factors. Factors and positive characteristics of businesses relating to chemical risk management interventions also include good reputation, market perception and quality.

Furthermore, networking and organizational learning are strategies that could be extensively used for better hazardous substances management in small companies. Stronger NGOs or other community groups may contribute by making companies take chemical substitution practices more seriously.

The recent Baltic Study on Environmental Responsibility that mainly focused on hazardous substances in small and medium size enterprises (SMEs) indicates that one of the main drivers for businesses to take greater environmental responsibility is national legislation or threat of enforcement. External stakeholders including the media, the general public and shareholders can also be important drivers of change.

Many businesses practice Corporate Social Responsibility (CSR) where environmental and social impacts must be identified, measured and reported. Responsible companies declare that they care about health, safety and employee well-being as well as respect for natural resources and the environment. Modern CSR schemes include substitution as precondition to responsible management, (UN Global Compact, OECD Responsible Business Conduct) but still, in reality, the level of commitment to substitution depends on maturity of the CSR within the company.

3.4 Challenges involved in communicating the messages of hazardous substance reduction

Some myths on chemical product use hindering any change of behaviour are deeply rooted at different business sectors, particularly among hairdressers and users of cleaning products. The following figure presents the essence of these misconceptions.

Figure 1: misconceptions on chemicals risk management

Arguments on the misconceptions:

- "If the product can be purchased, doesn't that automatically mean it is safe? If it was not safe, it would not be in the market." – this implies either that government institutions are in control of every product and article to reach the market or that businesses only produce and/or sell safe products. These statements misunderstand the difference between hazard and risk and that sometimes safety depends on the way the product or article is used. It also neglects the facts that not all particularly hazardous substances are yet restricted, not all hazardous substances have been identified, and there may be no alternatives to the hazardous substance in question.
- "I know this product is dangerous and causes cancer, but in our company it is only used very rarely, so there is no real harm" – like most of the myths above this one overlooks both long term cumulative effects and the potential that there is no safe exposure level to some groups of endocrine disrupting compounds. People are generally focused on immediate effects and how to avoid them, but long-term effect is harder to notice and may not be seen as immediate threat. Cumulative effects caused by exposure to, e.g., brominated flame retardants, over a long time period or cocktail effects possibly causing serious health effects may be harder to balance against immediate risks, e.g. fire. "Substances dangerous for human health are restricted and already banned" – similar to the first myth - often there is a misconception what is thought of as a hazardous substance. Not only toxic pesticides, nerve agents or acute poisons are hazardous. Hair dyes, toys and cleaning products can be hazardous as well.
- Regarding environmentally friendly products: "This 'natural' product (not ecolabelled) does not work as well as the other chemical products without eco-labelling" – this is a myth because natural products are not necessarily weaker or inferior in any way – they just have different chemical content or application instructions, including dosage. It is important to introduce a gradual approach here instead of promoting a step-wise change.
- "Environmentally and human health friendlier options are much more expensive", Substitution should be seen as a long-term investment in particular for substances that are likely to become restricted in the long run. Furthermore, substitution can vary from case to case, e.g. a technological investment can phase out hazardous substances use entirely and pay off in 5-10 years.

To conclude, these misconceptions may be difficult to deal with when working with businesses but explaining the advantages of safer products and importance of chemical substitution is one step closer to actual practice.

3.5 Political, economic, social and technological analysis (PEST)

There are number of factors that create opportunities or obstacles for substitution of hazardous substances by businesses. The potential opportunities and obstacles can be explored using Political, Economic, Social and Technological, or "PEST" analysis. Substitution is gaining more and more attention in the political arena. It is one of the key issues in the 7th Environmental Action Program (non-toxic environment) and multiple actors are putting their efforts into greening the chemicals industry.

Real and perceived economic factors are also important. Products containing less hazardous products are often perceived as being more expensive or less efficient than the products they could replace. In many cases businesses state that cost is the biggest barrier to substitution. It is advised to consider not only cost per application but rather the yearly cost review and take into account risks. Substitution is also about maintaining customer satisfaction as their awareness of hazardous substances is also increasing.

Today, both social and technological innovations are creating new opportunities for business and are becoming an intrinsic of our daily life. Social networking platforms provide unprecedented communication opportunities to raise awareness about hazardous substances and the potential for substitution. Multiple new technologies have emerged over recent years which allow companies to minimise, substitute or eliminate hazardous substances from production processes and articles. As these technologies are used more widely, their costs will continue to decline.

The PEST political, economic, social and technological analysis is presented in figure 2.

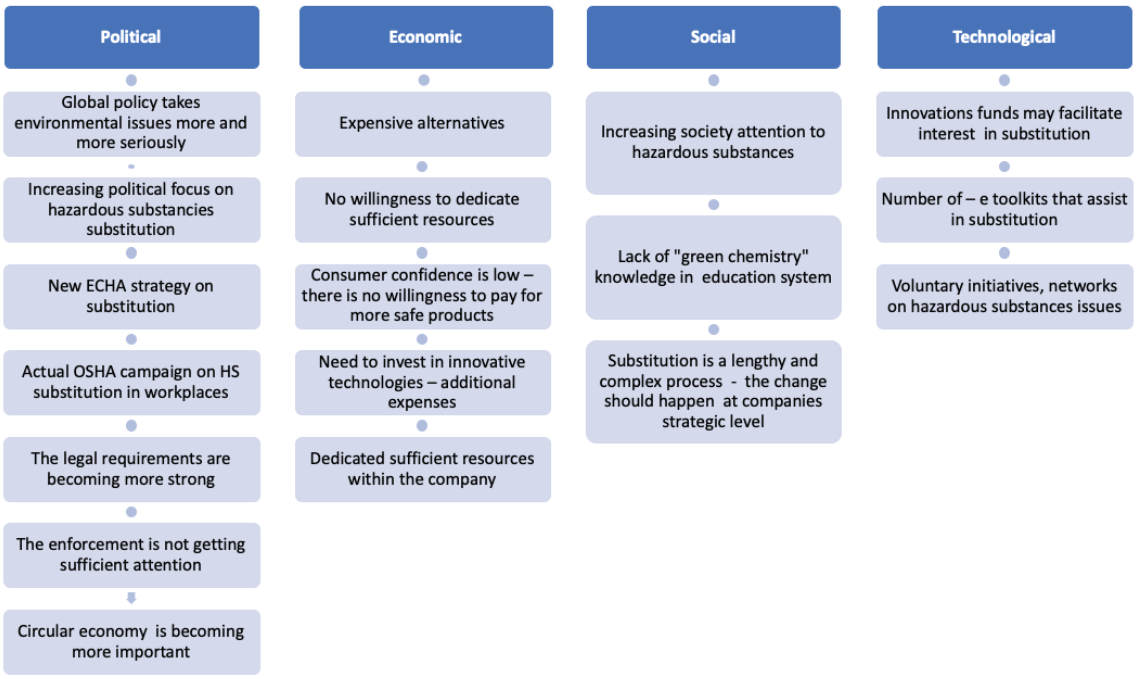

Figure 2. Factor analysis of hazardous substances reduction/substitution potential in businesses (PEST analysis)

4 CONCLUSIONS

Hazardous substances are present at worrying levels in our homes and workplaces. While we all can take action to reduce our exposure, businesses can play an especially important role. The majority of businesses have very little awareness of the amount of hazardous substances they use - including those in their day to day operations (e.g. hairdressing, car repair or cleaning services), in their workplaces (e.g. in furniture or office supplies), as well as in products, items and articles they sell to other businesses or consumers.

There are many ways municipalities can motivate business to reduce their use of hazardous substances. These include awareness raising, advice about hazardous substance substitution in the workplace, engaging with professional associations and trade organisations as well as better consideration of hazardous substances in the procurement process.

Small businesses are an especially important target group as many of them are at the end of a long and incompletely documented supply chain and, therefore, often lack awareness about the hazardous substances in the products they use. The NonHazCity project focussed on a number of different business sectors including hairdressers, professional cleaning services, car repair workshops and hotels as these end users often do not have sufficient competence on chemical issues.

Because they are not aware of their hazardous substance use, businesses generally are not concerned about the issue. Although the management of hazardous chemicals is complicated, simple and convincing ways to raise awareness about hazardous substances among businesses are needed.

The group training provided to businesses during the project helped to transfer knowledge, but one-on-one communication was also important as this is the best way of establishing an open and effective dialogue. Continuous training combined with integrated practical exercises had the greatest impact on businesses' substitution of hazardous substances.

Substitution of hazardous substances can be a simple exchange of one cleaning agent for another without much change in procedure or it can be a more thorough process, requiring quality controls, performance controls and approvals through an entire supply chain.

A key finding of the NonHazCity project is that business sectors which are end users of chemical products will need the most support. It is worth approaching small enterprises and service providers with training, information days, seminars and similar activities that do not put any obligations on participants. Companies are open to these types of events. And even though they will not immediately lead to quantifiable reduction of hazardous substances in business operations, chemicals will become a more open topic with possibly more willingness to cooperate and change in a longer term. It is possible to apply additional motivational instruments to encourage companies to participate directly in substitution activities, such as "green business awards" as a form of promotion as good examples by municipalities and others. However, in each municipality the possibilities to do this are very different and should be evaluated individually.

5 RECOMMENDATIONS

For municipalities

- Municipalities can and must play an important role in raising business' awareness about how they can substitute or reduce their use of hazardous substances. Face to face contact, seminars, information days and training material all contribute to awareness raising and action.
- Awards are an attractive way to recognise company efforts to substitute or reduce their use of hazardous substances and may encourage other businesses to take action.
- Monitoring and reporting of hazardous substances in waste water or surface waters will help to raise awareness about these issues.
- Chemicals-smart procurement and a related market dialogue is a powerful instrument for influencing suppliers to pay more attention to non-hazardous alternatives.

For businesses

- Businesses need to be aware that they almost certainly underestimate both their use of hazardous substances and the hazardous substance exposure of their staff and customers.
- Better supply chain communication is urgently needed. This will give benefits not only for awareness of hazardous substances but also for, e.g., ensuring correct deliveries, tracing of items and spare parts and increasing understanding between the different actors in the supply chain.
- Using chemical management systems and related initiatives will facilitate communication both within the supply chain and with customers.

For Society

- Environmental and consumer NGOs must raise awareness about hazardous substances in commonly used articles, products and materials and loudly communicate their request for products not containing hazardous substances, for less exposure and for more information on the ingredients.
- Education and training on sustainable chemistry, "non-toxic product design" and chemicals legislation is needed for all sectors of society. This includes chemists and any profession involved in the production, placing on the market, purchase and use of products and articles.

Commonly used articles, products and materials contain hazardous substances, and their use can damage our health as well as harming both indoor and outdoor environments. Municipalities can help businesses to play a much bigger role than today in decreasing the amount of hazardous substances in our homes, workplaces and environment. Facilitating cooperation among trade companies and raising awareness about chemicals present in articles, products and materials on the market can greatly reduce the impact of hazardous chemicals to human health and local (and regional) environment.

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ANNEX 1: LEGISLATIVE FRAMEWORK WITH RESPECT TO SUBSTITUTION OF HAZARDOUS SUBSTANCES AT WORKPLACES

Hazardous substances have been identified to be a major health and safety problem in workplaces. As a consequence every business using products containing hazardous substances in the work process is obliged to be in line with the respective European and national legislative framework on safety and health at work (OSH legislation).

For the management of products containing hazardous ingredients in workplaces the following overarching EU Directives are the most relevant:

- OSH Framework Directive (89/391/EEC) on the introduction of measures to encourage improvements in the safety and health of workers at work – the "Framework Directive"
- Chemical Agents Directive [CAD] (98/24/EC) on the protection of workers from the risks related to chemical agents at work
- Carcinogens and Mutagens Directive [CMD] (2004/37/EC) on the protection of workers from the risks related to exposure to carcinogens or mutagens at work

These EU directives are supplemented by various other OSH directives on binding and indicative occupational exposure limit values (overview at: https://osha.europa.eu/en/safety-and-health-legislation).

As the European legislation often lays down only general provisions EU member states are entitled to predefine more detailed and strict regulations for the protection of personnel at work. Hence, it is recommended to consult specific national OSH legislation in order to gain access to more exhaustive regulations.

The occupational safety and health legislation is closely related to the overall regulatory EU framework for chemicals which is laid down in the:

- REACH Regulation (EC No 1907/2006) concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals
- CLP Regulation (EC No 1272/2008) on Classification, Labelling and Packaging of substances and mixtures

Both regulations are important for the provision of information that is necessary for workplace risk assessment such as safety data sheets and labelling of hazards in accordance with the globally harmonised system of classification and labelling of chemicals (GHS).

Businesses upstream the supply chain and involved in the manufacturing of products, mixtures or materials are obliged to comply with the REACH regulation (ECHA, 2015).

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ANNEX 2: BASIC PRINCIPLES OF SUBSTITUTION OF HAZARDOUS SUBSTANCES IN BUSINESS WORKPLACES

Occupational legislation states that at first "... the employer of a business shall determine whether any hazardous chemical agents are present at the workplace. If so, he shall then assess any risk to the safety and health of workers arising from the presence of those chemical agents." (Article 4 of the Chemicals Agents Directive). A risk assessment helps to identify the right measures to prevent exposure to hazardous substances and provides the right information and training for workers.

The following consecutive steps are a practical approach to a risk assessment employers have to consider in order to eliminate and substitute hazardous chemicals/products from a work environment (EU-OSHA, 2018):

- Inventory all products and premises maintenance material present in workplaces
- Collect information on the specific hazards of products/mixtures from safety data sheets (SDS). SDS may be obtained from the supplier, manufacturer or internet.
- Assess exposure of employees to the identified dangerous substances (type, intensity, length, etc.)
- Draw up an action plan that lists the steps that must be taken, in priority order, to reduce the risk to employees
- Assess the impact and improvement of the preventive measures and revise if necessary

The following hierarchy of measures - known as the "STOP principle" –is propagated by the EU Chemical Agents Directive to prevent or reduce the exposure of workers to hazardous substances:

- **S**ubstitution – replace hazardous substances with safe (or at least safer) alternatives (e.g. concerning CLP classification) or decide elimination.
- **T**echnological measures or change of work process to minimise exposure
- **O**rganisational measures to replace hazardous substances
- **P**ersonal protective measures such as gloves and goggles

Substitution or elimination is the first measure to consider when a hazardous chemical has been identified in a material or product. A business should consider two basic questions:

- Is the use of a substance/products necessary at all?
- If the substance/product is needed, is there a safer alternative available?

References:

EU (2016) Health and safety at work is everybody's business. Practical guidance for employers. European Commission

OSHA (2018) Substitution of dangerous substances in the workplace. European Agency for Safety and Health at work,

OSHA (2018) Healthy workplaces – Manage dangerous substances. European Agency for Safety and Health at work

ANNEX 3: PROBLEMATIC SUBSTANCES FREQUENTLY PRESENT IN HAIRDRESSING AND COSMETIC PRODUCTS

Substance	Found in these products	Hazardous properties
Ammonia	hair dyes	respiratory and asthma irritant
p-phenylendiamine	colouring agent in hair dyes (coal-tar colour)	skin irritation, liver and blood toxicity, allergic reaction, birth defects
Diethanolamine (DEA) Monoethanolamine (MEA)		skin and respiratory toxicant; severe eye irritant; suspected carcinogen
Cocamide MEA & DEA	responsible for foaming properties of hair dye, shampoo, body wash, dandruff treatment, liquid hand soap, cleansers	cancer causing
Toluene	Ingredient of hair dyes	neurotoxin, allergy
Lead acetate	colour additive in hair dye products	neurotoxin
Sodium lauryl sulphate (SLS)	foaming products like shampoos, cleansers	can be contaminated with 1,4-dioxane, which is related to cancer
Cyclic siloxanes, cyclohexasiloxane, cyclopentasiloxane	common in cosmetics	may cause long-term adverse effects on aquatic organisms
Propylene glycol	Moisturizers, hand sanitizers, baby products, conditioners, shampoos.	linked to liver abnormalities and kidney damage.
Dibutyl phthalate	plasticizer in nail care products	suspected endocrine disrupter and reproductive toxin
PEG, PEG-derivate	applied as tensides or emulsifier in styling gel and hair wax	may cause allergies
Butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA)	hair products, makeup, sunscreen, shampoos, deodorants, fragrance, and creams; commonly used preservative	suspected of causing cancer, harmful to aquatic wildlife
Parabenes	widely used preservatives	endocrine disruptor
Methylisothiazolinone (MIT)	widely used preservative/ biocide	allergic reactions; may also be neurotoxic
Methylchloro-isothiazolinone	widely used preservative	allergic reactions; also some cancer concern
DMDM hydantoin	shampoos, hair conditioners, skin care products, moisturizers, bath products; acts anti-microbial by release of formaldehyde	

ANNEX 4: COMPILATION OF HAZARDOUS SUBSTANCES MOST OFTEN FOUND TO BE PRESENT IN HAIRDRESSING PRODUCTS USED AT A HAIRDRESSER SALON IN TURKU (FINLAND)

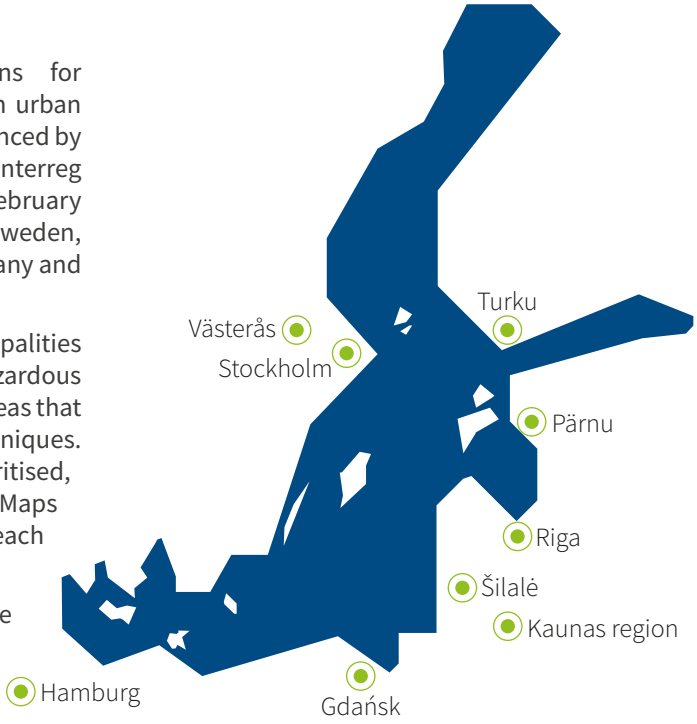
INCI name	CAS No.	CLP classification	Possible health hazard	Functions
Alpha-isomethyl ionone	127-51-5	H 315 – 317 – 320 – 401	allergen/immunotoxicity	perfuming, skin conditioning
Amyl cinnamal	122-40-7		allergen/immunotoxicity	perfuming
Behentrimonium chloride	17301-53-0	H 315 - 319 - 400 – 410	allergen	antistatic, hair conditioning, preservative
Benzyl alcohol	100-51-6	H332 - 302 – 319	Contact allergy	perfuming, preservative, solvent, viscosity controlling
Benzyl benzoate	120-51-4	H 302+312-315-332-401	allergen/contact dermatitis	antimicrobial, perfuming, solvent
Benzyl salicylate	118-58-1	H 315 - 319 – 335	allergen/immunotoxicity, endocrine disruption concern	perfuming, UV absorber
Ceteareth-20 (PEG-derivate)	68439-49-6	H 303 - 315 – 319	may contain toxic impurities	emulsifier, surfactant, solubilizing agent
Citronellol	106-22-9	H 315 - 317 - 319 – 411	possible human immune system toxicant or allergen	perfuming
Cocamidopropyl betaine	61789-40-0	H 319 – 315	Irritation and allergies	antistatic, cleansing, foaming, surfactant, viscosity controlling
Cyclopentasiloxane	541-02-6	H 361 – 413	may contain traces of cyclotetrasiloxane (D4) which is toxic to reproduction	emollient, hair and skin conditioning, solvent
Ethanolamine	141-43-5	H 302 - 312 - 332 – 314	human skin toxicant, allergen, human immune and respiratory toxicant or allergen - can cause asthma	buffering
Ethylhexyl methoxycinnamate	5466-77-3	H 315 - 319 - 335	hormone activity, EDC (endocrine disrupting substance)	UV absorber, UV filter
Geraniol	106-24-1	H 315 - 318 – 317	allergen	perfuming, tonic
Hexyl cinnamal	101-86-0	H 317 - 400 – 411	allergen/immunotoxicity	perfuming
Hydroxycitronellal	107-75-5	H 315 – 318	allergen/immunotoxicity	perfuming
m-Aminophenol	591-27-5	H 302 - 332 – 411	strong sensitizer	hair dyeing,
Methylparaben	99-76-3	H 412	EDC	preservative
Phenoxyethanol	122-99-6	H 302 – 319	irritant after constant exposure	preservative
Resorcinol	108-46-3	H 302 - 315 - 319 – 400	skin irritant, toxic to the immune system, can cause allergy, EDC	hair dye, hair lotion and shampoos
Toluene-2,5-diamine sulfate	95-70-5	H 301-312+332-317-411	very sensitizing, absorbed through skin, toxic	hair dyeing
Triethanolamine	102-71-6	H 319	human immune and respiratory toxicant, allergen	emulsifying, masking, surfactant

ABOUT THE PROJECT

The project “Innovative Management Solutions for Minimizing emissions of hazardous substances from urban areas in the Baltic Sea Region” (NonHazCity) was financed by the European regional development fund within the Interreg Baltic Sea Region program, from March 2016 to February 2019. The project involved 18 partners from Sweden, Finland, Estonia, Latvia, Lithuania, Poland and Germany and 23 associated partners.

NonHazCity demonstrated the possibilities of municipalities and WWTPs to reduce emissions of priority hazardous substances (HS) from small scale emitters in urban areas that cannot be reached by traditional enforcement techniques. Substances of concern were identified and prioritised, sources tracked and ranked, individual HS Source Maps and Chemicals Action Plans were developed by each partner municipality.

Municipal entities implemented own substance reduction measures at their premises. Private small scale businesses have undertaken pilot substitution actions and improved their assortment. Inhabitants have been shown their HS emission share and tested the use of less HS in every-days household management to help to protect the Baltic Sea environment but also their own health.



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