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Identification of POP candidates for the Stockholm Convention

NIPH
Norwegian Institute of Public Health

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Executive summary

More than 10000 chemicals are known to be used as additives in plastics (1). Known PBT characteristics, production volumes and empirical data were sued to evaluate their potential for nomination to the Stockholm Convention. A *5-Tiered* approach was used to identify 9 chemicals for further investigation. Additional Chemicals of Interest are also suggested for further follow up with respect to similar usages (UV-compounds) or suggested P&B properties (Liquid crystal monomers).

Introduction

The Norwegian Environment Agency is in the process of identifying persistent organic pollutant (POP) candidates for possible new nominations under the Stockholm Convention. The Norwegian Environment Agency requested the Norwegian Institute of Public Health (NIPH) to identify new substances used as additives in plastics that might meet the criteria of the Stockholm Convention. Single candidate or candidate groups should be present in Norwegian nature or Arctic habitats or indications of possible health and environmental harmful effects should be reported.

Methods

We used a multitiered approach as illustrated in Figure 1 see Results and Discussion chapter for a more detailed description. As a starting point, we used two overview papers evaluating the available information of additives used in plastics (*1, 2)*. More than 10,000 chemicals are summarized in both publications, together with their estimated PBT characteristic, regulatory status, production status and use area in a variety of polymers. Glüge *et al.* was used in the next steps of selection for information on bioconcentration factors (BCF) and their lipophilic properties as described by their octanol-water partition coefficients (K_{ow}) *(3)*. In addition, we used the PBT categorization by Wiesinger *et al.* using following criteria or Persistency, Bioaccumulation and Toxicity:

Persistency	A substance fulfills the persistence criterion (P) in any of the following situations: a) the degradation half-life in marine water is higher than 60 days; b) the degradation half-life in fresh or estuarine water is higher than 40 days; c) the degradation half-life in marine sediment is higher than 180 days; d) the degradation half-life in fresh or estuarine water sediment is higher than 120 days; e) the degradation half-life in soil is higher than 120 days. A substance fulfills the 'very persistent' criterion (vP) in any of the following situations: a) the degradation half-life in marine, fresh or estuarine water is higher than 60 days;

	b) the degradation half-life in marine, fresh or estuarine water sediment is higher than 180 days; c) the degradation half-life in soil is higher than 180 days.
Bioaccumulation	A substance fulfills the bioaccumulation criterion (B) when the bioconcentration factor in aquatic species is higher than 2000. A substance fulfills the 'very bioaccumulative' criterion (vB) when the bioconcentration factor in aquatic species is higher than 5000.
Toxicity	Chronic aquatic toxicity, Specific organ toxicity upon repeated exposure, Carcinogen, mutagen or reproductive toxicant (CMR) or Endocrine disruption

To evaluate the toxicology of the suggested chemicals in accordance with the Stockholm Convention, Annex D (https://chm.pops.int/Default.aspx?tabid=2806), we combined the toxicity evaluation by Wiesinger *et al., (1)*, that only covers ecotoxicological considerations, with information of human/mammalian toxicity, (Appendix II). European Chemical Agency's (ECHA's) homepages were screened for information related to present regulatory status (e.g. if substance of very high concern (SVHC; requires authorization), eventual harmonized classification (e.g. PBT/vPvB or Repr.1B), if undergoing PBT assessment, if subject to substance evaluation in community rolling action plan (CoRAP)). Moreover, human toxicity relevant hazard statements (self-reported) were collected, and data/study dossiers were looked into (if available) for information on lipophilicity ($\log K_{ow}$) and human/mammalian (often rat) toxicity study summaries. This information is summarized in Appendix II below. Due to time constraints, databases such as PubMed, Web of Science, were not searched in for relevant scientific articles. For one substance, QSAR was used to predict toxicity for one endpoint. Due to time constraints, databases such as PubMed, Web of Science, were not searched in for relevant scientific articles.

High production volume of a chemical was defined as > 10,000 t/yr (sum of US+EU or on the OECD HPVC list (data from Wiesinger *et al*. (1)).

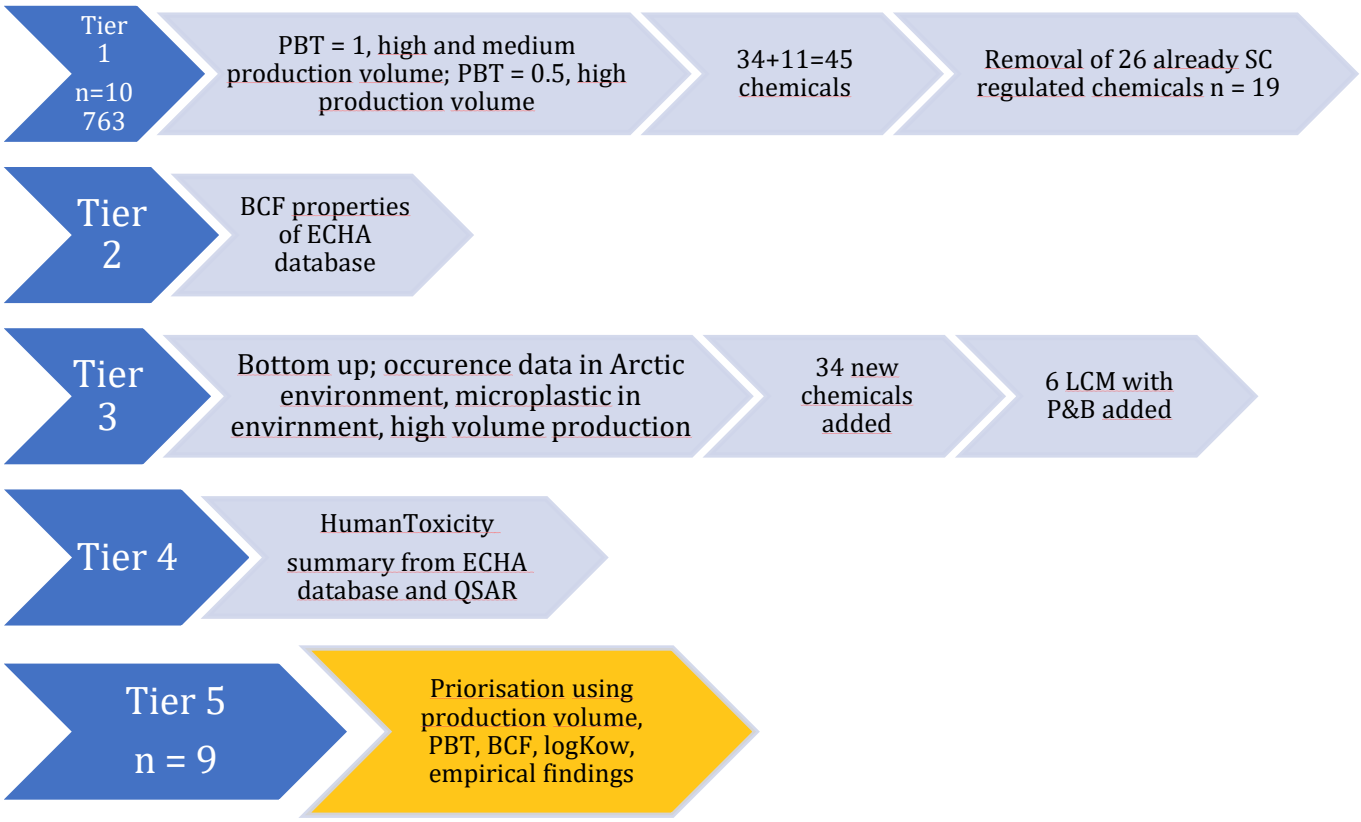


Figure 1: Illustration of approach for selection of chemicals

Results

Many more substances than considered in this study may be persistent and/or bioaccumulative, as we used PBT assessment outcomes as listed in the REACH PBT assessment list. However, we chose to include also compounds which were still undergoing PBT evaluation (PBT criteria ranking = 0.5 in Wiesinger *et al.*). Further, by the inclusion of empirical data, additional chemicals were included even if they were listed with the PBT criteria = 0. Our decision to include these compounds anyway was based on the fact they were of high production volume and either found to be under PBT assessment (UV234), found in the Arctic environment or in biota (UV 326 and DBDPE). Wiesinger *et al*. also states that substances that are registered under REACH fulfilling the P and/or B criteria were not identified in their study, due to time and resource constraints to individually check their REACH registration dossiers.

Selection of chemicals

As a *First Tier*, we filtered the list of chemicals from *(1)* according to PBT criteria being fulfilled (PBT=1) and high and medium high production volume (>10,000 and >1000 t/yr globally). This resulted in 34 individual chemicals. After a second round of filtering with lowered PBT criteria (0.5, under revision) and production volume > 100 t/yr, additional 11 compounds of interest were identified. Within these 45 chemicals, several were

already listed in the Stockholm Convention (Chlorinated paraffins, several PFAS, PBDEs, Dechloran plus, UV-328). PAH were removed since they are listed in the EU-POP regulation due to their LRT capabilities, even if they are not on the SC list due to also having natural sources. After their removal, 19 individual chemicals were left (Table 1).

Table 1: Additives with all PBT criteria and high-medium production volumes fulfilled according to *(1, 2)*

CAS #	**SHORT NAME**	NAME
HIGH AND MEDIUM VOLUME PRODUCTION, PBT =1*		
540-97-6	D6	Cyclohexasiloxane, 2,2,4,4,6,6,8,8,10,10,12,12-dodecamethyl-, (D6)
541-02-6	D5	Cyclopentasiloxane, 2,2,4,4,6,6,8,8,10,10-decamethyl-, (D5)
556-67-2	D4	Cyclotetrasiloxane, 2,2,4,4,6,6,8,8-octamethyl-, (D4)
4979-32-2		2-Benzothiazolesulfenamide, N,N-dicyclohexyl-
732-26-3		Phenol, 2,4,6-tris(1,1-dimethylethyl)-
3846-71-7	UV320	Phenol, 2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-
3864-99-1	UV327	Phenol, 2-(5-chloro-2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-
36437-37-3	UV350	Phenol, 2-(2H-benzotriazol-2-yl)-4-(1,1-dimethylethyl)-6-(1-methylpropyl)-
HIGH PRODUCTION VOLUME, PBT 0.5		
597-82-0		Phosphorothioic acid, O,O,O-triphenyl ester
141-62-8	L4	Tetrasiloxane, 1,1,1,3,3,5,5,7,7,7-decamethyl-
141-63-9	L5	Pentasiloxane, 1,1,1,3,3,5,5,7,7,9,9,9-dodecamethyl-
121-03-9		Benzenesulfonic acid, 2-methyl-5-nitro-
1530-32-1		Phosphonium, ethyltriphenyl-, bromide (1:1)
62125-22-8		Isooctadecanoic acid, 1,1'-[2,2-bis[[(1-oxoisooctadecyl)oxy]methyl]-1,3-propanediyl] ester
28472-97-1		Nonanedioic acid, 1,9-diisodecyl ester
83834-59-7		2-Propenoic acid, 3-(4-methoxyphenyl)-, 2-ethylhexyl ester, (2E)-
100-01-6		Benzenamine, 4-nitro-
66492-51-1		2-Propenoic acid, (5-ethyl-1,3-dioxan-5-yl)methyl ester

* According to Wiesinger et al. *(1)*

Among these 19 chemicals, 4 benzotriazoles (UV compounds), 5 siloxanes (cyclic and linear), one benzothiazole and a variety of other chemicals were identified.

Due to the high abundance of benzotriazoles, we added the following congeners and octocrylene to our list, which were originally not identified by *(1, 2)*, but are known to be found in plastic:

- UV 329 2-(2H-1,2,3-benzotriazol-2-yl)-4-(2,4,4-trimethylpentan-2-yl)phenol
- UV 326 2-tert-butyl-6-(5-chloro-2H-benzotriazol-2-yl)-4-methylphenol
- Octocrylene

The *Second Tier* involved the collection of BCF information for the identified chemicals according to Glüge *et al.* a, b, covering 5318 substances *(3, 4)*. For the chemicals from the *Tier 1* approach, BCFs varying between 1229 for octocrylene and 62343 for L5 were found. BCFs of 4 of the selected chemicals were not listed, but a potential for bioaccumulation in aquatic species was highlighted for all 4 of them. The Annex D requirement of a BCF > 5000 was only fulfilled by AO-1076 (12656), L5 (62343) and L3 (11913).

The *Third Tier* was a "bottom up" approach, collecting empirical data on the occurrence of the identified and additional relevant chemicals in a) Biota, to indicate bioconcentration capabilities, b) the Arctic, to indicate persistence and long range transport capabilities, c) Occurrence in environmental microplastic pollution to identify chemicals not covered by (*1, 2)* and d) Other chemicals of certain interest. We used reports by the Norwegian Environmental Agency (Screening 2018 & 2019, TemaNord 2020, MIKRONOR2021 and 2022) *(25-31)* together with recent peer reviewed literature *(5-7)*. The work conducted here is not a full review or systematic review, mainly a screening of available information with both grey and peer reviewed literature.

By this process, of the pre-identified chemicals, UV compounds were found in air samples from Svalbard, octocrylene and UV compounds were found in seabird eggs and linear siloxanes were found in both air samples from Svalbard and seabird eggs. Further, two new chemicals of interest were identified:

- 1,3 –Diphenylguanidine, identified as PBT candidate by Screening 2019 (TemaNord2020)
- Irgafos 168; Tris(2,4-ditert-butylphenyl) phosphite, identified in numerous plastic samples.

By applying *Tier 1 and 2* process on both chemicals, 1,3 –Diphenylguanidine was found to be medium production volume (20,000 tons) and BCF<1 and logKow<4, while Irgafoss 168 is produced at high volumes of 200,000 tons, a high estimated logKow of 18 but little

information on BCF. We did not continue to evaluate 1,3 –Diphenylguanidine but added Irgafos 168.

Available scientific literature on identified additives in microplastic found in the environment is scarce. We used *(5-7)* for additional chemicals of relevance in relation to their production volume of at least 10,000 t. We found 52 additional chemicals, that were reduced to 10 after applying the production volume criteria. After referring to the overview by Wiesinger *et al.*, we included also a number of homologues that also fulfilled the criteria of high-volume production (Table 2).

Table 2: Plastic additives identified using *Bottom-up* approach.

SHORT NAME	CAS #	CHEMICAL
	102-06-7	1,3 –Diphenylguanidine
IRGAFOS 168	31570-04-4	Tris(2,4-ditert-butylphenyl) phosphite
IRGAFOS 126/ ULTRANOX 626	26741-53-7	2,4,8,10-Tetraoxa-3,9-diphosphaspiro[5.5]undecane, 3,9-bis[2,4-bis(1,1-dimethylethyl)phenoxy]-
BBP	85-68-7	1,2-Benzenedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester
DEHP	117-81-7	1,2-Benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester
DEHT, DOTP	6422-86-2	1,4-Benzenedicarboxylic acid, 1,4-bis(2-ethylhexyl) ester
DBP	84-74-2	1,2-Benzenedicarboxylic acid, 1,2-dibutyl ester
DEP	84-66-2	1,2-Benzenedicarboxylic acid, 1,2-diethyl ester
DINP	28553-12-0	1,2-Benzenedicarboxylic acid, 1,2-diisononyl ester
BISPHENOL AF	1478-61-1	Phenol, 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-
OCTABENZONE	1843-05-6	Methanone, [2-hydroxy-4-(octyloxy)phenyl]phenyl-
AO-1076	2082-79-3	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, octadecyl ester
AO-1010, IRGANOX 1010	6683-19-8	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, 1,1'-[2,2-bis[[3-[3,5-bis(1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropoxy]methyl]-1,3-propanediyl] ester
	42774-15-2	1,3-Benzenedicarboxamide, N1,N3-bis(2,2,6,6-tetramethyl-4-piperidinyl)-
	97416-84-7	Benzene, 1,1'-(1-methylethylidene)bis[3,5-dibromo-4-(2,3-dibromo-2-methylpropoxy)-
DBDPE	84852-53-9	Benzene, 1,1'-(1,2-ethanediyl)bis[2,3,4,5,6-pentabromo-
	2530-87-2	Silane, (3-chloropropyl)trimethoxy-
	75-77-4	Silane, chlorotrimethyl-
	75-54-7	Silane, dichloromethyl-
	5089-70-3	Silane, (3-chloropropyl)triethoxy-
	141-57-1	Silane, trichloropropyl-
	1066-35-9	Silane, chlorodimethyl-
UV 329	3147-75-9	2-(2H-1,2,3-benzotriazol-2-yl)-4-(2,4,4-trimethylpentan-2-yl)phenol
UV 326	3896-11-5	2-tert-butyl-6-(5-chloro-2H-benzotriazol-2-yl)-4-methylphenol
OCTOCRYLENE	6197-30-4	Octocrylene

Chemicals of certain interest

Liquid crystal monomers (LCM). As chemicals of certain interest, we reviewed Liquid Cristal Monomers identified in house dust and LCD displays *(8)*. Most of the identified 33 LCMs are fluorinated organic compounds, with some of them also belonging to the PFAS group according to OECD definition *(9)*, (Figure 2). Of the 33 chemicals, 10 were identified having vPvB characteristics by the authors.

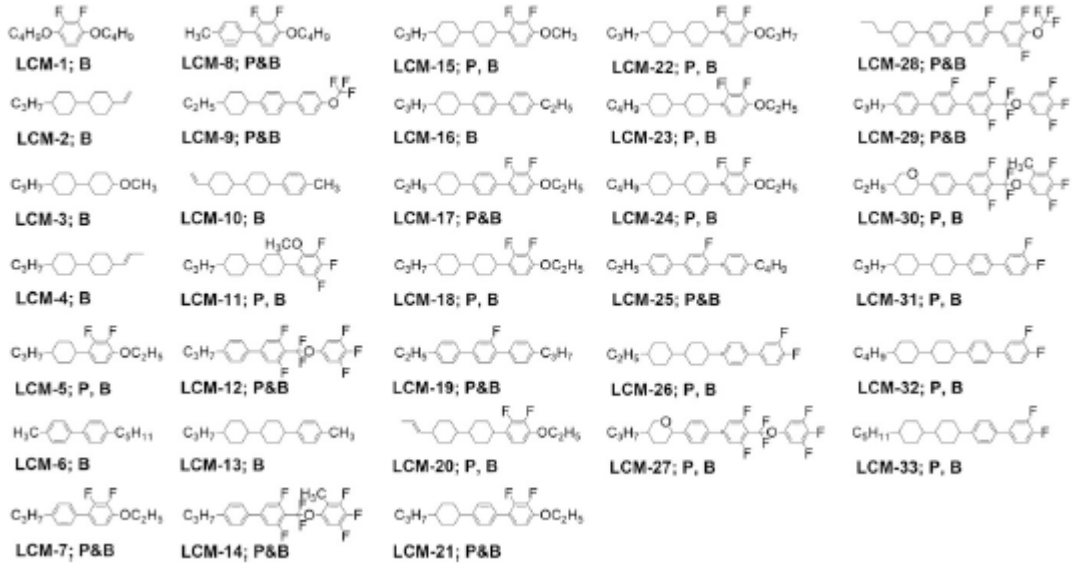


Figure 2: Chemical structures and P&B properties of 33 LCMs identified in LCD devices, taken from *(8)*.

Since LCM-12 gave raise to both parenteral and pup toxicity in a combined repeated dose toxicity with repro/developmental toxicity screening test in rats at relatively low doses (see Appendix II), a QSAR prediction was performed for LCM-21 using the ProtoPRED (www.protoqsar.com) platform and developmental toxicity (human and animal data, in vivo prenatal) QSAR model. The prediction (based on 4 methods, 3 were within the applicability domain) was 'positive'. However, since the 10 structurally closest neighbours had Tanimoto similarity coefficients of just 0.51 (#1)-0.41(#10) out of maximum 1, and since LCM-7 and LCM-17, which is structurally very similar to LCM-21, did not produce toxicity in reproduction/developmental toxicity screening tests (rat) (Appendix II), this prediction seems uncertain.

Phthalate metabolites. Due to their very high production volumes (Figure 3) and ubiqueous presence in humans and the environment we did not want to disregard phthalates totally. Phthalates have been found in air, dust, drinking water, sludge, sediments, soil, aquatic life and animals (Net et al., Gao et al., Puri et al.). Several phthalates

are also know to be able to reach the Arctic with for example DEP, BBP, DEHP and DPHP dominating in air samples at Zeppelin station, Svalbard (Screening report, 2020). The transport of phthalates into the environment occurs via industrial, municipal, and household emissions. Studies have shown that phthalates can be biodegraded by various aerobic or anaerobic microorganisms *(10, 11)*. However, their half-lives not only depend upon the type of phthalate but also on the many external factors such as pH, temperature, microbial strain, microbial density, and sunlight *(10, 11)*. For example, longer half-lives are observed under anaerobic conditions, and half-lives of phthalates are in order of several years at neutral pH *(11)*. The primary biodegradation products of phthalates are through hydrolysis, which results in formation of mono alkyl phthalates *(10, 12-14)*, (Table 3). These mono-alkyl phthalates can be further oxidized to several polar metabolites like alcohols, ketones and carboxylic acids especially for the high-molecular weight phthalates like DEHP and DiNP *(15, 16)*, (Table 3). Many of the metabolites produced in biota through hydrolysis and oxidation for example in samples from cattle (15) and porcine (16) are similar to metabolites produced in humans *(17)*, (Table 3). Some of the mono-alkyl phthalate metabolites produced after their hydrolysis were also found in blue mussels, crabs and fish samples, indicating at bioconcentration and/ or metabolic formation *(12, 18-22)*. Routti et al. measured phthalates in blubber from whales and adipose tissue from polar bears from the Norwegian Arctic region (Barents and Greenland seas) *(23)*. Among 12 different phthalates measured, DEHP was the only phthalate that was at quantifiable concentrations. Further, phthalate metabolites were found in plasma from polar bears (metabolites of DnBP and DiBP, namely MnBP and MiBP), adding to the evidence of bioconcentration of these metabolites via prey and/ or metabolic degradation due to the presence of their parent compounds, phthalates.

Even if they metabolise fast, their chronic exposure can cause elevated concentrations of their metabolites in organisms resulting in harmful effects.

Table 3: Parent phthalates and their corresponding metabolites

CAS #	Parent phthalate	Metabolite
85-68-7	1,2-Benzenedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester (BBzP)	Mono benzyl phthalate (MBzP)
117-81-7	1,2-Benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester (DEHP)	Mono-2-ethylhexyl phthalate (MEHP)
		Mono-2-ethyl-5-hydroxyhexyl phthalate (MEHHP)
		Mono-2-ethyl-5-oxohexyl phthalate (MEOHP)
		Mono-2-ethyl 5-carboxypentyl phthalate (MECPP)
6422-86-2	1,4-Benzenedicarboxylic acid, 1,4-bis(2-ethylhexyl) ester (DEHTP)	Mono-2-ethylhexyl terephthalate (MEHTP)

		Mono-2-ethyl-5-hydroxyhexyl terephthalate (MEHHTP)
		Mono-2-ethyl-5-oxohexyl terephthalate (MEOHTP)
		Mono-2-ethyl 5-carboxypentyl terephthalate (MECPTP)
84-74-2	1,2-Benzenedicarboxylic acid, 1,2-dibutyl ester (DBP)	Mono-butyl phthalate (MBP)
53306-54-0	1,2-Benzenedicarboxylic acid, 1,2-bis(2-propylheptyl) ester (DPHP)	6-Hydroxy Monopropylheptylphthalate (OH-MPHP)
84-66-2	1,2-Benzenedicarboxylic acid, 1,2-diethyl ester (DEP)	Monoethyl phthalate (MEP)
28553-12-0	1,2-Benzenedicarboxylic acid, 1,2-diisononyl ester (DiNP)	Mono-4-methyl-7-hydroxyoctyl phthalate (OH-MiNP)
		Mono-4-methyl-7-oxooctyl phthalate (oxo-MiNP)
		Mono-4-methyl-7-carboxyoctyl phthalate (cx-MiNP)

Toxicological properties of the preselected POP candidates.

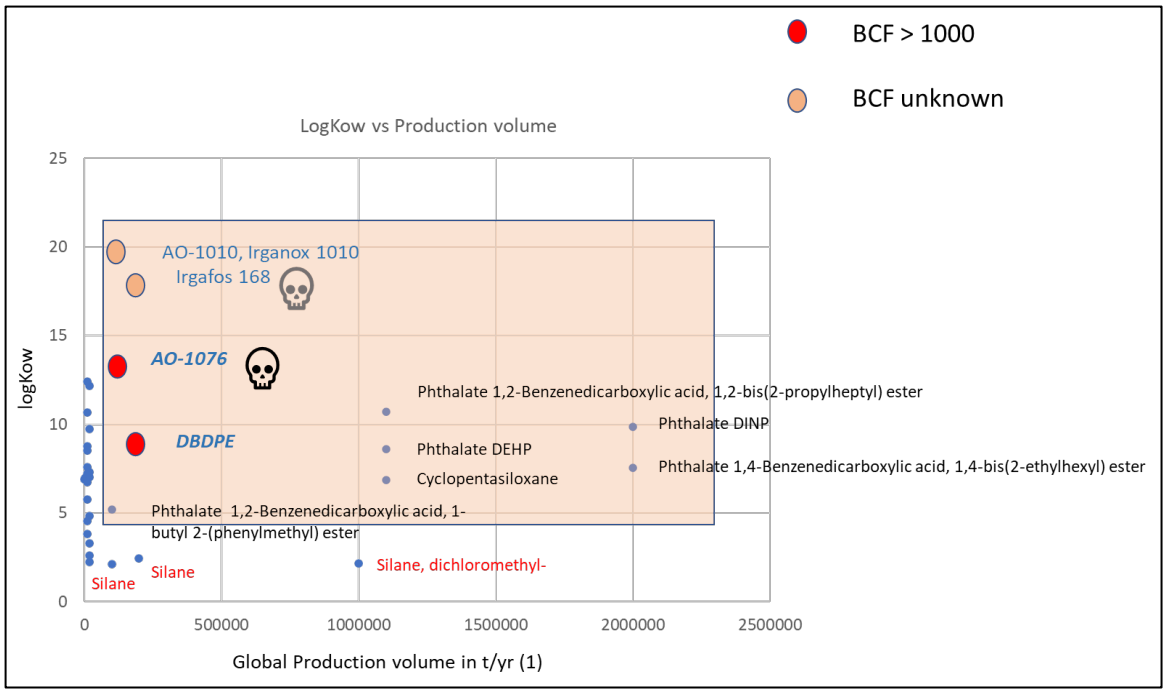
Tier 4. See Annex 2 for an overview over the collected information for every considered chemical including chemical structures.

Selection of chemicals suggested for priorization

Tier 5. After removing all chemicals with a production volume < 2000 t, BCF < 1000, logKow < 4, all phthalates and cyclic siloxanes, the chemicals shown in Table 4 were kept for prioritization. Phthalates were excluded due to low bioaccumulation due to biodegradation, cyclic siloxanes due to the nomination report published at ECHA website List of substances proposed as POPs - ECHA (europa.eu). The 13 chemicals are listed with decreasing PBT criteria score. Their regulatory status, production volume, $\log K_{ow}$, PBT properties including calculated BCF and other data can be found in the Excel table, Appendix I. Molecular structures and toxicological properties are shown in Appendix II.

Table 5 lists *Chemicals of Interest* with no or only little information regarding production volume and PBT. They belong either to a compound group already listed in Table 4 (UV compounds) and potentially used in similar volumes and applications and express comparable PBT characteristics or are polyfluorinated aromatic compounds with reported P&B characteristics (LCMs).

Figure 3 illustrates the selection of chemicals listed in Table 4. When comparing log Kow with production volume, the antioxidants AO-1010 and 1076, Irgafos 168 and DBDPE are marked because they express high production volumes > 100,000 t/yr and log K_{ow} > 4 (with red circle: BCF >1000 or Orange circle: BCF unknown). The lower panel in Figure 3 illustrates the chemicals with a production volume between 10,000 and 20,000 t/yr.



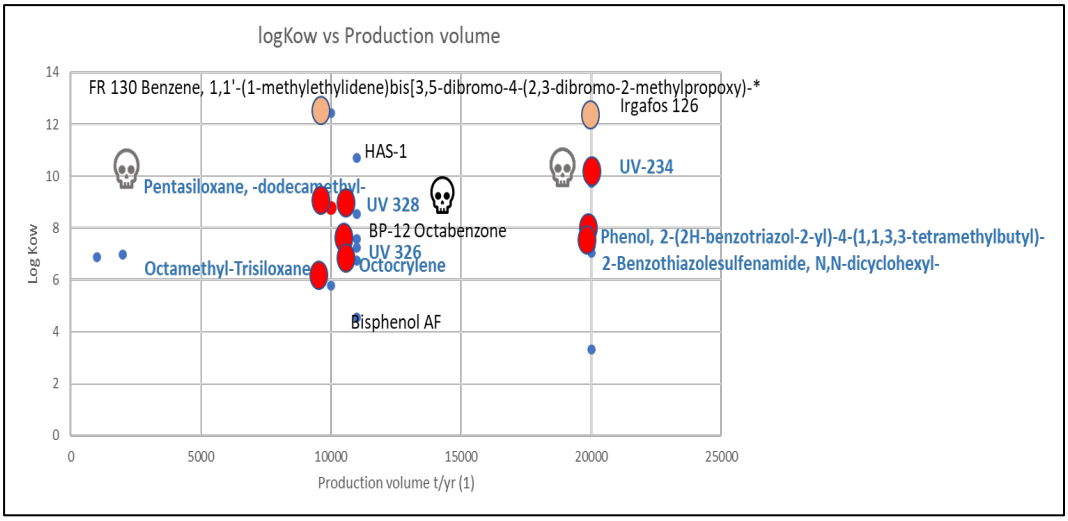


Figure 3: Comparison of log Kow with production volume in t/yr, Upper panel: orange box: Chemicals with log Kow > 4 and production volume between 20,000 and 2,000,000 t/yr. Lower panel: Chemicals with log Kow > 4 and production volume 10,000-20,000 t/yr. Compound marked with red circle: BCF >1000, Orange circle BCF unknown; Font in blue = Suggested for prioritization; Skull symbolizes reported toxicity.

Table 4: Selected plastic additives for further evaluation as POP candidates in decreasing order of PBT criteria fulfilled *(1)*, for more details on identified toxicity, see Appendix 2 :

Short name	CAS #	Name	Toxicity Evaluation***	PBT criteria fulfilled *(1)***	Detection in the environment**	Detection in the Arctic **	Compartments W, S, A, B, MP
	4979-32-2	2-Benzothiazolesulfenamide, N,N-dicyclohexyl-	CoRAP and undergoing	3			
AO-1010, Irganox 1010	6683-19-8	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, 1,1'-[2,2-bis[[3-[3,5-bis(1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropoxy]methyl]-1,3-propanediyl] ester	No mammalian T evidence	1			
AO-1076	2082-79-3	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, octadecyl ester	Some T evidence	0.5			
AP 1300 S; FR130	97416-84-7	Benzene, 1,1'-(1-methylethylidene)bis[3,5-dibromo-4-(2,3-dibromo-2-methylpropoxy)-	No T evidence	0.5			
L5	141-63-9	Pentasiloxane, 1,1,1,3,3,5,5,7,7,9,9,9-dodecamethyl-	CoRAP included	0.5	Y	Y	A
L4	107-51-7	Octamethyl-Trisiloxane	CoRAP included	0.5	Y	Y	A
OPFR	597-82-0	Phosphorothioic acid, O,O,O-triphenyl ester	CoRAP included	0.5			
Irgafos 168	31570-04-4	Phenol, 2,4-bis(1,1-dimethylethyl)-, 1,1',1''-phosphite	Slight T evidence	0	Y		MP
UV-234	70321-86-7	Phenol, 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)-	Some T evidence	0			

*already on SC list since 2023, W, S, A, B, MP= Water, Soil, Air, Biota, environmental microplastic pollution (based on *(5-7; 25-31)*), **Empty cells do not reflect no detection in the environment, ***human/ mammalian toxicology evaluation; **** Number of PBT criteria (persistence, bioaccumulatio and toxicity) fulfilled according to REACH Article 57, reach from 0 (no criteria fulfilled) to 3 (P,B and T criterion fulfilled), with 0.5 = not enough data

Table 5: Suggested additional plastic additives for further evaluation as POP candidates, with lacking data on production volume, chemicals in bold indicate PBT properties:

	CAS #	Name	Toxicity Evaluation***	Detection in the environment**	Detection in the Arctic**	Compartments W, S, A, B, MP
Other UV compounds						
UV 320*	3846-71-7	Phenol, 2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-	No data	Y	Y	A, B, MP
UV 327*	3864-99-1	Phenol, 2-(5-chloro-2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-	No data	Y		A, B, MP
UV-329	3147-75-9	Phenol, 2-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)-	No data	Y	Y	A
UV 326	3896-11-5	Phenol, 2-(5-chloro-2H-benzotriazol-2-yl)-6-(1,1-dimethylethyl)-4-methyl-	No T evidence	Y	Y	A, B, MP
UV 350*	36437-37-3	Phenol, 2-(2H-benzotriazol-2-yl)-4-(1,1-dimethylethyl)-6-(1-methylpropyl)-	No data			MP
Liquid Crystal Monomers						

LCM-7	**157248-24-3**	**4-Ethoxy-2,3-difluor-4'-propyl-1,1'-biphenyl**	**Some T evidence**	**Housedust**		
LCM-12	**303186-20-1**	**4-*difluoro(3,4,5-trifluorophenoxy)-methyl]-3,5-difluoro-4'-propyl-1,1'-biphenyl**	**Some T evidence**			
LCM-8		1-butoxy-2,3-difluoro-4-(4-methylphenyl) benzene	No data	Housedust		
LCM-9	650634-92-7	1-(4-ethylcyclohexyl)-4-[4-(trifluoromethoxy)phenyl]benzene	No data	Housedust		
LCM-14	1690317-23-7	1,1'-Biphenyl, 4- [difluoro (3,4,5-trifluoro-2-methylphenoxy)methyl]-3,5-difluoro-4'-propyl-	No data	Housedust		
LCM-21	189750-98-9	4-ethoxy-2,3-difluoro-4'- ((1r,4s)-4-propylcyclohexyl)-1,1'-biphenyl	No data	Housedust		

*ECHA hearing August 2023; W, S, A, B, MP= Water, Soil, Air, Biota, environmental microplastic pollution (based on *(5-7, 25-31)*), ** Empty cells do not reflect no detection in the environment, ***human/ mammalian toxicology evaluation

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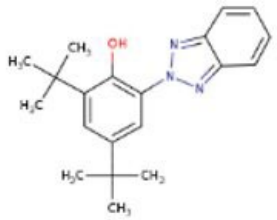
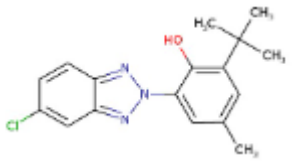
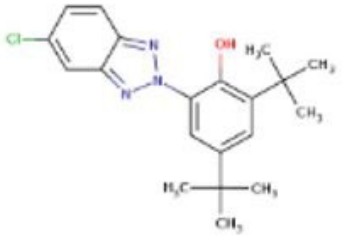
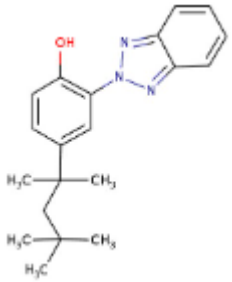
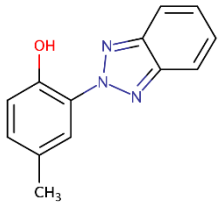
Appendices

Appendix I Excel file with collection of available information on PBT criteria, production volume, regulatory status, logKow, BCF on the selected chemicals.

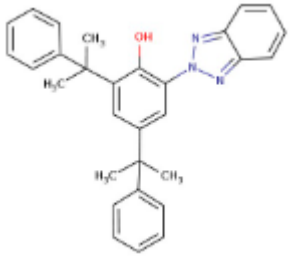
Appendix II Information from ECHA's homepage regarding candidate POPs regulatory status and human/mammalian related toxicity.

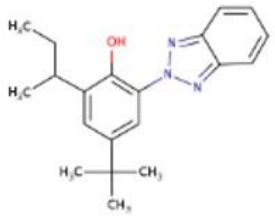
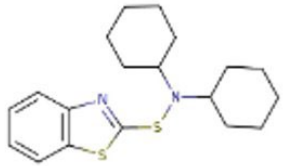
Short name & structure	CAS#	Name(s) & stated lipophilicity	Yearly tonnage in EU (ECHA) / regulatory status	T Info from registration dossier	Notified classification & labelling, CLP
UV-320 	3846-71-7	Phenol, 2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-(2-benzotriazol-2-yl-4,6-di-tert-butylphenol; 2-benzotriazol-2-yl-4,6-di-tert-butylphenol logKow=4.63 & 5.07 & 5.17 (calculated, info from SVHC support document year 2014)	Not used or possibly 1 to 10 tons. Requires authorisation SVHC (PBT&vPvB)	Data (study) dossier not found on ECHA's homepage for this CAS nr. However, several notifiers mention **organ (liver, kidney) toxicity from repeated administration** More information can likely be found in SVHC document(s)	Hazard statements: STOT RE (liver, kidney &other organs), carc. No harmonized CLP classification
UV-326 	3896-11-5	Phenol, 2-(5-chloro-2H-benzotriazol-2-yl)-6-(1,1-dimethylethyl)-4-methyl-; Bumetrizole logKow= >6.5	≥ 1 000 to < 10 000 Under PBT assessment	ADME: no studies available, but stated "**there may be a potential to accumulate**" due to its high lipophilicity, distribution into cells and fatty tissues, if systemically available. Acute LD50 (rat): oral: > 2000 mg/kg bw; dermal: > 2000 mg/kg bw. NOAEL=1000 mg/kg bw/d for P0 and F1 (highest dose tested). Reproduction toxicity (prenatal dev tox, rat): NOAEL (fetal developmental and maternal tox)=3000	Hazard statements: eye&skin irritant, acute tox, STOT SE (resp.). No harmonized CLP classification

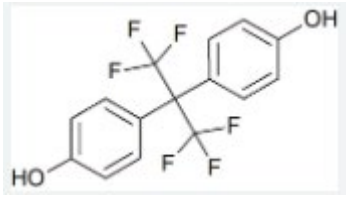
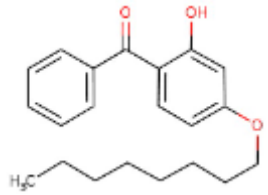
				mg/kg bw/d (highest dose tested). Endocrine (estrogen and constitutive androstane receptor): negative	
UV-327 	3864-99-1	Phenol, 2-(5-chloro-2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)- (2,4-di-tert-butyl-6-(5-chlorobenzotriazol-2-yl)phenol; 2,4-di-tert-butyl-6-(5-chlorobenzotriazol-2-yl)phenol logKow=6.91 & 7.91 (calculated, info from SVHC proposal year 2015)	Not used or possibly 1 to 10 tons. Requires authorisation SVHC (vPvB), undergoing PBT assessment	Data (study) dossier not found on ECHA's homepage for this CAS nr. However, several notifiers mention **organ (liver, kidney) toxicity from repeated administration**	Hazard statements: eye/skin/lung irritant, STOT RE (liver, kidney &other organs). No harmonized CLP classification

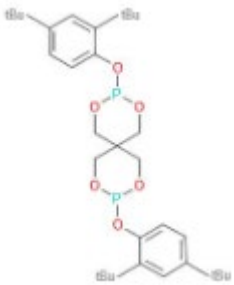
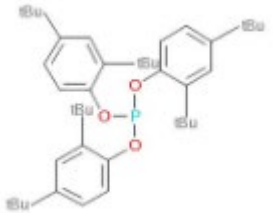
UV-329 / UV-5411 	3147-75-9	Phenol, 2-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)-; octrizole logKow= >6.5	≥ 1 000 to < 10 000 Under PBT assessment	ADME: no data. *Based on read-across from Tinuvin P (CAS 2440-22-4), having greater water solubility, low bioaccumulation potential is stated for UV-329.* Acute (oral): LD50 (rat) > 10 000 mg/kg bw; (dermal): LD50 (rabbit) > 5000 mg/kg bw.	Hazard statements: eye&skin irritant, STOT SE (resp.), acute tox, skin sens.. No harmonized CLP classification
Tinuvin P: Cas No 2440-22-4  Used for read-across to UV-329		*2-(2H-benzotriazol-2-yl)-p-cresol* *logKow= >6.5*	*≥ 1 000 to < 10 000* *Under PBT assessment, CoRAP included*	*ADME (rat): rapid absorption and distribution; elimination (91% within 48 h) mainly through urine; possibly phase II conjugation. Stated no bioaccumulation potential. Repeated dose toxicity (feeding rat, 2-year) NOEL=1000 ppm (47-58 mg/kg bw/d), NOAEL=3000 ppm (142-169 mg/kg bw/d, highest dose tested, 3000 ppm had somewhat lower food*	*Hazard statements: eye irr., skin sens., acute tox., STOT RE.* *No harmonized CLP classification*

				intake during second year, but not considered adverse). Repeated dose toxicity (gavage rat, combined repeated dose toxicity w repro/dev tox screening test (42d(M)/53d(F)): NOAEL=30 mg/kg bw/d based on ***kidney lesions*** *in M&F. Overall, administration through feeding was considered more relevant than gavage, so NOAEL=142 mg/kg bw/d (from 2-year study). Reproduction toxicity (rat, combined repeated dose toxicity w repro/dev tox screening test: NOAEL=300 mg/kg bw/d (parenteral and F1 offspring), highest dose tested. Reproduction toxicity (prenatal dev tox, rat): NOAEL (fetal developmental and maternal tox)=1000 mg/kg bw/d*	
UV-234	70321-86-7	Phenol, 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)-	≥ 1 000 to < 10 000	ADME: No studies exist, but oral repeated dose testing indicates that at least some substance is absorbed and	Hazard statements: eye&skin irritant, STOT

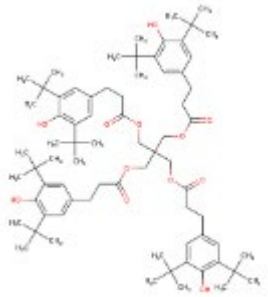
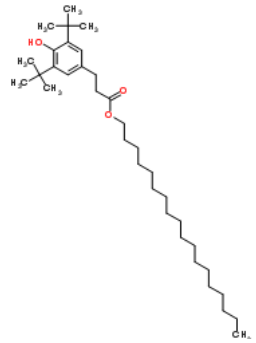
		logKow= >6.5	Under PBT assessment	reaches the liver. Stated "low bioaccumulation potential". Poorly water soluble. Acute: LD50 (oral, rat) > 7750 mg/kg bw; (dermal, rat): LD50 (rat) > 2000 mg/kg bw. Irritation/corrosion (dermal, rabbit): non-irritant; (eye, rabbit): non-irritant. Skin sensitization (in vivo): not sensitizing. Repeated dose toxicity (rat 90d): NOAEL=22.5 (M)/22.1 (F) (300 ppm) mg/kg bw/d, **liver effects (weight increase, hepatocyte hypertrophy/vacuolization),** reversible at 300 ppm, non-recoverable at 2000 (152.7(M)/155.1(F)) and 10 000 ppm (779.5/801.2). NOEL=50 ppm (3.7 mg/kg/bw). Repeated dose toxicity (rat 28d): NOAEL=10 000 ppm (933.8 (M&F) mg/kg bw). NOAEL (fetal developmental and maternal tox)=3000 mg/kg bw/d (highest dose tested).	SE (resp.irr. & drows./dizz.). No harmonized CLP classification

UV-350 	36437-37-3	Phenol, 2-(2H-benzotriazol-2-yl)-4-(1,1-dimethylethyl)-6-(1-methylpropyl)-; (2-(2H-benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol logKow=6.31 & 7.11 (calculated, info from SVHC proposal year 2015)	Not used or possibly 1 to 10 tons. Requires authorisation SVHC (vPvB), undergoing PBT assessment	Data (study) dossier not found on ECHA's homepage for this CAS nr. However, several notifiers mentions **organ (liver) toxicity from repeated administration**	Hazard statements: eye irritant, STOT RE (liver&other organs). No harmonized CLP classification.
Rubenamid DS or Sulphenamide DCBS [rubber vulcanization slow accelerator] 	4979-32-2	2-Benzothiazolesulfenamide, N,N-dicyclohexyl-; N,N-dicyclohexylbenzothiazole-2-sulphenamide; DCBS; Rubenamid DS logKow=5.95	≥ 1 000 to < 10 000 CoRAP included, undergoing PBT assessment	ADME: no TK study is available in the dossier, but stated likely to be readily absorbed (rat), to distribute into many organs (e.g. fat), to likely undergo extensive liver metabolism (into e.g. MBT and (di)cyclohexylamine; a claim supported by OECD QSAR Toolbox) and subsequent excretion (stated half-life of 53 h, but unclear for what) of metabolites into faeces and urine. May undergo enterohepatic recirculation, and possibly metabolism/hydrolysis in G.I. tract.	Hazard statements: acute tox, eye/skin irritant,skin sens., STOT SE (resp. irr.). No harmonized CLP classification.

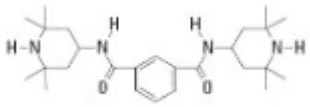
Bisphenol AF 	1478-61-1	Phenol, 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis- logKow=2.79	≥ 100 to < 1 000	ADME: in rat&mouse ADME (oral & i.v.) studies BPAF is well absorbed, but also rapidly cleared (elim t1/2 ≤ 4.22 h) after extensive conjugation (low bioavailability).	Hazard statements: reprotoxic, eye dam., eye irr., skin irr., STOT RE (lungs& organs). No harmonized CLP classification
BP-12 	1843-05-6	Methanone, [2-hydroxy-4-(octyloxy)phenyl]phenyl-; Benzophenone 12; octabenzone logKow=7.6	≥ 1 000 tonnes CoRAP included	ADME: in a 35-day repeated rat study 10% of dose appeared in urine as glucuronic conjugate and remainder eliminated unchanged in feces.	Hazard statements: skin sensitising, skin irr., eye irr. No harmonized CLP classification

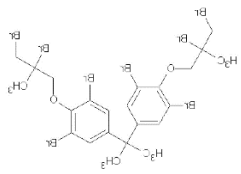
Irgafos 126/ Ultranox 626 	26741-53-7	2,4,8,10-Tetraoxa-3,9-diphosphaspiro[5.5]undecane, 3,9-bis[2,4-bis(1,1-dimethylethyl)phenoxy]- logKow=10.9	≥ 1 000 to < 10 000	ADME: In water the substance is expected to be instable and to dissolve slowly into di-tert-butylphenol and phosphate.	Hazard statements: eye irr./dam., skin irr./corr., STOT SE (resp.irr.). No harmonized CLP classification
Irgafos 168 	31570-04-4	Phenol, 2,4-bis(1,1-dimethylethyl)-, 1,1',1''-phosphite; tris(2,4-ditert-butylphenyl) phosphite (antioxidant) logKow=18	≥ 10 000 to < 100 000 Under PBT assessment	Acute (oral): LD50 (rat, mouse, hamster)>6000 mg/kg bw; (dermal) LD50 (rat) > 2000 mg/kg bw; (intraperitoneal): LD50 (rat) > 2000 mg/kg bw. Repeated dose toxicity (rat 105 w (chronic)): NOAEL=58 mg/kg bw/d (2000 ppm, highest dose) caused no toxicity. Repeated dose toxicity (dog 90d): NOEL>318 mg/kg bw/d (8000 ppm, highest dose) caused no effects. Repeated dose toxicity (rat 90d): NOEL=500 mg/kg bw/d due to kidney and liver weight effects seen at	Hazard statements: eye&skin irritant, acute tox. No harmonized CLP classifications

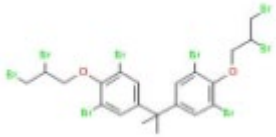
				500/1000 mg/kg bw/d, but reversible after 4 weeks (→NOAEL>=1000 mg/kg bw/d). Carcinogenicity (rat, 2-year): no tumour incidence increase at NOAEL=58 mg/kg/bw/d (2000 ppm, highest dose tested). Reproduction toxicity (two-generation study, rat): NOAEL(fertility F0)=411 mg/kg bw/d (4000 ppm) (**reduced fertility at 10 000 ppm);** NOAEL (development, F1/F2)=10 000 ppm (highest dose tested). Reproduction toxicity (prenatal dev tox study, rabbit): NOAEL(development)=1200 mg/kg bw/d (highest dose tested). Endocrine (estrogen activity in juvenile rats): no indication	
AO-1010	6683-19-8	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, 1,1'-[2,2-bis[[3-[3,5-bis(1,1-dimethylethyl)-4-hydroxyphenyl]-1-	≥ 10 000	The diameter of the chemical was determined to be 17.9 Å. According to a publication by Opperhuizen et al, a lipophilic particle with a diameter of	Hazard statements: acute tox, carcinogenesis.

		oxopropoxy]methyl]-1,3-propanediyl] ester; Pentaerythritol tetrakis(3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate) logKow=19.6		greater than 9.5 Å has only limited ability to cross biological membranes (Opperhuizen et al, 1985), and apparently no adverse effects observed (from ADME summary). The carcinogenicity studies are negative (hazard statement not supported)	No harmonized CLP classification
AO-1076 	2082-79-3	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, octadecyl ester; Octadecyl 3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate; Antioxidant 1076 logKow= 13.4	≥ 10 000	ADME: rat ADME studies supports reasonable (31.6-55.9%) absorption within 3 h (only N=1), and relatively rapid elimination (96% of dose within 168hrs after single dose: 35% in urine/61% in faeces (N=4). Highest organ level after 168 h in heart).. Acute (oral): LD50 (rat) > 5000 mg/kg bw; (inhalation): LD50 (rat) > 1.81 mg/L; (dermal): LD50 (rat) > 2000 mg/kg bw. Irritation/corrosion (dermal, rabbit): transient slight erythema/edema, reversible effects (non-irritant); (eye,	Hazard statements: eye&skin irritant, skin sens., STOT SE (resp. irr.). No harmonized CLP classification

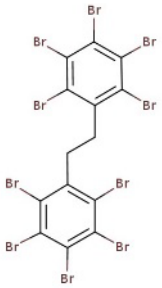
				rabbit): mild and mostly transient chemosis and conjunctivae findings (non-irritant). Skin sensitization (in vivo): not sensitizing. Repeated dose toxicity (dog 90d): NOAEL=34 mg/kg bw/d (non-reversible liver weight increase at higher dose levels). Repeated dose toxicity (rat 104 w (chronic): NOAEL=64(M)/81(F) mg/kg bw/d (**non-reversible liver and thyroid weight increase at higher dose levels**). Repeated dose toxicity studies are also available for 28d (rat) and 90d (mouse), but are less relevant. Genetic toxicity, several in vitro (bacteria) and in vivo studies: all non-mutagenic/negative outcomes. Reproduction toxicity (two-generation study, rat): NOAEL=315(M)/373(F) (5000 ppm, highest dose)	

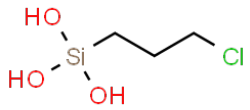
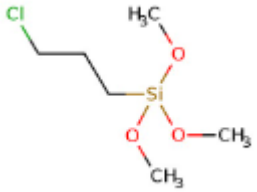
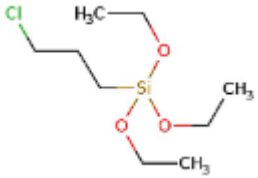
				mg/kg bw/d for fertility (parenteral) and F1 and F2 generations. NOEL was lower (1500 (parenteral) & <500 ppm (F1&F2)) as **effects on organ weights and histological changes** were observed, but were not considered adverse. Reproduction toxicity (prenatal dev tox, rat&mouse): NOAEL>1000 mg/kg bw/d (fetal development) (highest dose tested). Endocrine (estrogen activity): negative; (androgen receptor binding): negative	
	42774-15-2	1,3-Benzenedicarboxamide, N1,N3-bis(2,2,6,6-tetramethyl-4-piperidinyl)-; Nylostab S-EED Log Kow= 1.12	≥ 1 000	Acute (oral): LD50 (rat) =1253 mg/kg bw; (dermal): LD50 (rat) > 2000 mg/kg bw. Irritation/corrosion (dermal, rabbit): non-irritant; (eye, rabbit): **irritant**. Skin sensitization (in vivo): not a skin sensitizer. Repeated dose toxicity (oral rat, 28d) NOAEL=1000 mg/kg bw/d; (oral rat, 90d)	Hazard statements: acute tox, eye irritant. No harmonized CLP classification

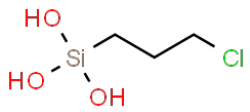
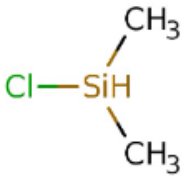
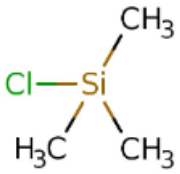
				NOEL=450 mg/kg bw/d (highest dose tested). Genetic toxicity, in vitro (bacteria, mammalian cell) studies: all non-mutagenic/negative outcomes. Reproduction toxicity (one-generation reproduction toxicity study, rat): parenteral and offspring NOAEL=540 mg/kg bw/d (highest dose tested). Reproduction toxicity (prenatal dev tox, rat): NOAEL (fetal developmental tox)=1000 mg/kg bw/d; NOAEL (maternal)=250 mg/kg bw/d due to reduction in bw gain and food consumption	
AP 1300 S, FR130 	97416-84-7	Benzene, 1,1'-(1-methylethylidene)bis[3,5-dibromo-4-(2,3-dibromo-2-methylpropoxy)-; AP 1300 S; FR130, Ecoflame B-972 Log Kow= 12.42	≥ 1 000 to < 10 000 Under ED assessment; CoRAP included	Acute (oral): LD50 (rat) > 2000 mg/kg bw. (Read-across from TBBPA-DBPE used for dermal and inhalation.) Irritation/corrosion (dermal&eye (in vitro/ex vivo)): non-irritant. Repeated dose toxicity: read-across from TBBPA-DBPE.	No hazard statements

				Genetic toxicity, in vitro (bacteria, mammalian cell): non-mutagenic/negative. Genetic toxicity, in vivo: read-across from TBBPA-DBPE for in vivo somatic cell genotoxicity. Reproduction toxicity (rat): read-across from TBBPA (CAS 79-94-7)	
TBBPA-DBPE  'Similar Substance 1' used for read-across to AP 1300 S/FR130	*21850-44-2*	*1,1'-propane-2,2-diylbis[3,5-dibromo-4-(2,3-dibromopropoxy)benzene]); TBBA; FR-720; TBBPA-DBPE*		*Acute (oral): LD50 (rat) > 2000 mg/kg bw: (dermal): LD50 (rabbit) > 2000 mg/kg bw;* *(inhalation): LC50 (mouse) > 87 mg/l (WHO 1995 publication), (inhalation): LC50 (rat) > 24.4 mg/l.* *Repeated dose toxicity (several studies available; data for mouse oral (NTP study)): NOEL (14 weeks) =100 mg/kg.* ***Adverse findings (e.g. increased liver weight, decreased kidney weight,*** *...) at 500 and 1000 mg/kg.* *Genetic toxicity, in vivo (rat, somatic cell genotoxicity, unscheduled DNA synthesis assay): no effects observed.*	*No hazard statements*

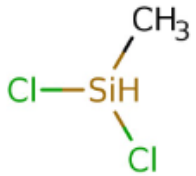
				Data from other studies and end-points exist in TBBPA-DBPE dossier	
TBBPA  'Similar Substance 2' used for read-across to AP 1300 S/FR130 for the Reproduction toxicity endpoint	*79-94-7*	*2,2',6,6'-tetrabromo-4,4'-isopropylidenediphenol, TBBPA*	*≥ 10 000 to < 100 000* *Under ED and PBT assessment. CoRAP included*	*Reproduction toxicity (rat): NOAEL (fertility, two-generation reproduction toxicity study)=1000 mg/kg bw/d.* ***In F1&F2 thyroid effects (lower serum T4) were observed at higher doses.*** *NOAEL (development)=2500 mg/kg bw/d (Noda, 1985 scientific article; exposure in pregnant rats, no abnormalities seen in pups on post-natal day 21)* Data from other studies and end-points exist in TBBPA dossier	*Hacard statements: eye/skin irr., STOT SE (resp.), carc.* *Harmonized CLH: Aquatic Acute 1, Aquatic chronic 1*
DBDPE	84852-53-9	Benzene, 1,1'-(1,2-ethanediyl)bis[2,3,4,5,6-pentabromo- ; Decabromodiphenyl ethane (DBDPE, EBP) Log Kow=3.55.	≥ 10 000 to < 100 000 Under PBT assessment; CoRAP	Acute (oral): LD50 (rat) > 5000 mg/kg bw; (dermal): LD50 (rabbit) > 2000 mg/kg bw. Irritation/corrosion (dermal&eye (in vivo)): non-irritant.	No (human health) hazard statements

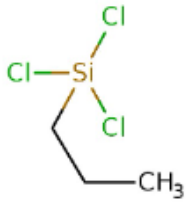
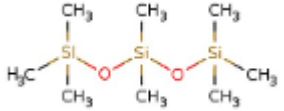
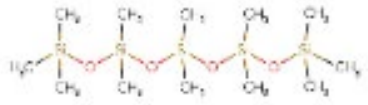
				Skin sensitization (in vivo): not a skin sensitizer. Repeated dose toxicity (oral rats, 28&90d): NOEL (28d) =1.250 mg/kg & NOAEL (90d) = 1000 mg/kg bw/day (at 1000 mg/kg bw/day: liver changes (e.g. weight increase) in M, but disappeared during 28d recovery period). Reproduction toxicity (DNT, rat): systemic toxicity (maternal) NOAEL=1000 mg/kg/d. **Offspring brain morphometric effects in M at 100, 300 and 1000 mg/kg/d, but unclear if method artefacts** (no NOAEL for DNT could be determined). Reproduction toxicity (mouse, guideline not stated. Low reliability): perinatal exposure increased risk of obesity in offspring. Reproduction toxicity: EOGRTS with DNT cohort study planned	

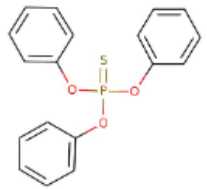
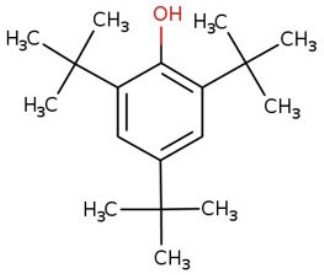
  →Hydrolysis in water→	2530-87-2	Silane, (3-chloropropyl)trimethoxy- Log Kow= -1 [hydrolysis product], 2 [parent substance]	≥ 1 000 to < 10 000		Hazard statements: skin/eye irr., STOT SE (resp.), but for parent molecule. No harmonized CLP classification
 →Hydrolysis in water→	5089-70-3	Silane, (3-chloropropyl)triethoxy- Log Kow= -1 [hydrolysis product], 3.13 [parent substance]	≥ 1 000 to < 10 000		Hazard statements: skin/eye irr., STOT SE (resp.), but for parent molecule.

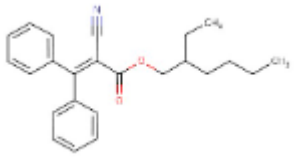
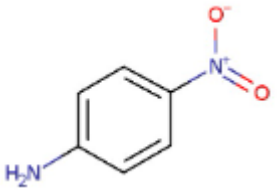
					No harmonized CLP classification
 →Hydrolysis in water	1066-35-9	Silane, chlorodimethyl- Chlorodimethylsilane Log Kow= 0.6 [hydrolysis product], not stated for parent substance	≥ 1 000 to < 10 000		Various hazard statements: skin corr, eye damage, acute tox, but for parent molecule. No harmonized CLP classification
	75-77-4	Silane, chlorotrimethyl- Chlorotrimethylsilane Log Kow= 1.19 [hydrolysis product], not stated for parent substance	≥ 10 000 to < 100 000	*From the TMS (CAS 1066-40-6) dossier:* *ADME: TMS is very water soluble. Calculated blood-tissue partitioning coefficients suggest it could distribute into fat (11.9:1), but also that due*	Various hazard statements: skin corr, eye damage, acute tox, STOT SE, Carc (although

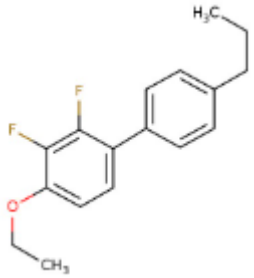
→Hydrolysis in water				*to its high calculated soluble fraction (90%) in blood, that it will be eliminated by kidneys into urine.* *Acute (oral): LD50 (rat)=3.5 ml/kg bw (2835 mg/kg bw).* *Acute (inhalation, 4hrs): LC50 (rat)=3151 ppm (11.8 mg/l).* *Irritation/corrosion (dermal&eye(rabbit): non-irritant.* *Skin sensitization (in vivo): no study available (TMS evaporates). 10 similar substances (read-across) are negative.* *Repeated dose toxicity (rats, oral, 28d): NOAEL=250 mg/kg bw/day. Toxicity (body weight, increased liver&adrenal weight, clinical parameters)) at 750 mg/kg bw/day.* *Genetic toxicity, several in vitro (bacteria, mammalian cell) and in vivo studies: all non-mutagenic/negative outcome.* *Reproduction toxicity (oral prenatal development study, rat): NOAEL=150 mg/kg/day*	no carc study available), but for parent molecule. No harmonized CLP classification

				for maternal and developmental toxicity. Toxic effects at 450 mg/kg/day (maternal body weight effects, reduced fetal weight, delayed ossification, increased incidence of cartilaginous variations in offspring, but which may be due to maternal toxicity). *Reproduction toxicity (inhalation, combined repeated dose toxicity w repro/dev tox screening test): no adverse effects observed at highest dose (NOAEC ≥600 ppm)*	
 →Hydrolysis in water	75-54-7	Silane, dichloromethyl- Dichloro(methyl)silane Log Kow= -0.955 [hydrolysis product], not stated for parent substance	≥ 100 000 to < 1 000 000		Various hazard statements: skin corr, eye damage, acute tox, STOT SE (resp.), but for parent molecule. No harmonized

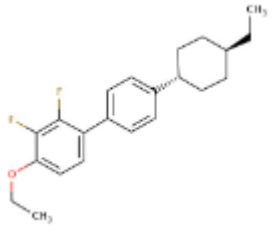
					CLP classification
 →Hydrolysis in water	141-57-1	Silane, trichloropropyl- Trichloro(propyl)silane Log Kow= -1.4 [hydrolysis product], not stated for parent substance	≥ 100 to < 1 000		Various hazard statements: skin corr, eye damage, acute tox, but for parent molecule. No harmonized CLP classification
Linear siloxane (L3)  →Hydrolysis in water	107-51-7	Octamethyltrisiloxane; L3 Log Kow=6.6	≥ 1 000 to < 10 000 CoRAP		No human tox hazard statements
Linear siloxane (L5) 	141-63-9	Pentasiloxane, 1,1,1,3,3,5,5,7,7,9,9,9-dodecamethyl-; dodecamethylpentasiloxane; L5 Log Kow=9.411	≥ 1 000 to < 10 000 CoRAP (handled by Norway)	Several animal studies exist (various end-points), but were not looked into since substance evaluation is handled by Norway	Hazard statements: eye/skin irr., STOT SE (resp.) No harmonized

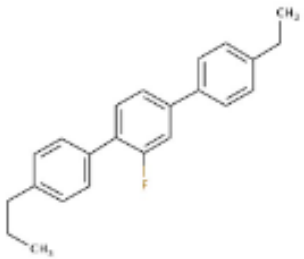
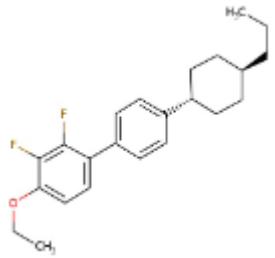
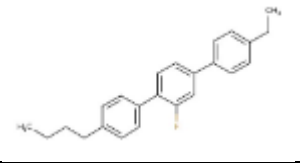
					CLP classification
OPFR 	597-82-0	O,O,O-triphenyl phosphorothioate Log Kow=5	≥ 100 to < 1 000 Under PBT assessment; CoRAP		Hazard statement: reprotox. No harmonized CLP classification.
 2,4,6-tri-tert-butylphenol	732-26-3	Phenol, 2,4,6-tris(1,1-dimethylethyl)-(2,4,6-tri-tert-butylphenol); 2,4,6-tri-tert-butylphenol Log Kow=7.1	≥ 100 to < 1 000		Harmonized CLH classification for **Acute Tox. 4, Skin Sens 1B, STOT RE2, Repr. 1B.**
Octocrylene	6197-30-4	Octocrilene Log Kow=6.1	≥ 1 000 to < 10 000 CoRAP included, undergoing		No human T relevant hazard statements presented

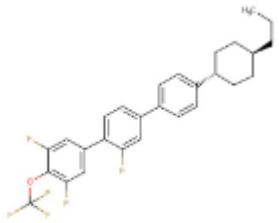
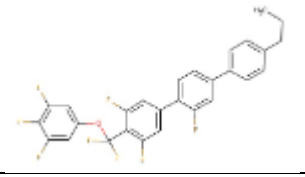
			PBT assessment		
	100-01-6	Benzenamine, 4-nitro-; 4-nitroaniline Log Kow=1.2	≥ 1 to < 10		
Phthalates metabolites				T not investigated	

LCM-7 	157248-24-3	4-Ethoxy-2,3-difluor-4'-propyl-1,1'-biphenyl Log Kow=6.3	≥ 1 to < 10	Acute (oral): LD50 (rat) > 2000 mg/kg bw. Irritation/corrosion (dermal&eye (in vitro/ex vivo)): non-irritant. Skin sensitization (in vivo): not a skin sensitizer. Repeated dose toxicity (rats): NOAEL=300 mg/kg bw/day for systemic toxicity (see Repro. tox. below). Genetic toxicity, in vitro (bacteria, mammalian cell) studies: all non-mutagenic/negative outcome. Reproduction toxicity (combined repeated dose tox w repro-/dev-tox screening test, rats): regarding reproduction parameters, no treatment-related effects were noted at 100 and 300 mg/kg bw/d. The NOAEL regarding systemic toxicity and reproduction parameters is considered to be 300 mg/kg bw/d. **Doses of 600/1000 were clinically not tolerated.**	No hazard statements provided Claimed P&B (Su, 2019)

LCM-8	NA (unclear identity, not found)		Not ECHA registered?	-	Claimed P&B (Su, 2019)
LCM-9 (PFAS structure= may become regulated)	650634-92-7		Cas nr not ECHA registered	-	Claimed P&B (Su, 2019)
LCM-12 (PFAS structure)	303186-20-1	4-[Difluor(3,4,5-trifluorphenoxy)methyl]-3,5-difluor-4'-propyl-1,1'-biphenyl logKow= >6.5	≥ 1 to < 10	Acute (oral): LD50 (rat read-across) > 2000 mg/kg bw. Irritation/corrosion (dermal&eye (in vitro/ex vivo)): non-irritant. Skin sensitization (in vivo read-across): not a skin sensitizer. **Repeated dose toxicity** (rats): LOAEL=5 mg/kg bw/day, **see Repro. tox.** Reproduction toxicity (combined repeated dose tox w repro-/dev-tox screening test used, rats): **parenteral toxicity (testes, epididymides, uterus) observed at lowest dose** (LOAEL=5 mg/kg bw/day). Toxicity in other organs (thymus, thyroid glands, spleen, liver, adrenal gland) at	Harmonized CLH classification: **Repr. 1B** Claimed P&B (Su, 2019)

				higher doses. **Unhealthy offspring, pup death. Repr. 1B warranted**	
LCM-14 (PFAS structure)	1690317-23-7		Cas nr not ECHA registered	-	Claimed P&B (Su, 2019)
LCM-17 	323178-01-4	4-ethoxy-4'-(trans-4-ethylcyclohexyl)-2,3-difluoro-1,1'-biphenyl logKow= >6.5	≥ 1 to < 10	Acute (oral): LD50 (rat) >2000 mg/kg bw. Irritation/corrosion (dermal (in vivo)): non-irritant. Eye(in vivo read-across)): no relevant irritating potential (minor adverse effects). Skin sensitization (in vivo read-across to two analogues): not a skin sensitizer. Reproduction toxicity (repr./dev tox. screening test, rat): no adversity observed (→NOEL=1000 mg/kg bw/d for repro./ dev. tox.; parental NOAEL=1000 mg/kg bw/d)	No hazard statements presented. Claimed P&B (Su, 2019)

LCM-19 	95759-44-7	4''-Ethyl-2'-fluor-4-propyl-1,1':4',1''-terphenyl logKow= >5.7	≥ 1 to < 10	Acute (oral&dermal): LD50 (rat) > 2000 mg/kg bw. Repeated dose toxicity (rat oral, 28d): urinal changes (non-adverse) at 1000 mg/kg and **minimal hypertrophy of centrilobular hepatocytes** in some males and females at 200 and 1000 mg/kg/day (but reversible effects). NOAEL=1000 mg/kg.	No hazard statements provided. Claimed P&B (Su, 2019)
LCM-21 	189750-98-9 [has 2 EC numbers: 685-368-6 & 921-136-5 (for dossier)]	4-ethoxy-2,3-difluoro-4'-(trans-4-propylcyclohexyl)-1,1'-biphenyl logKow= >6.5	≥ 1 to < 10	Acute (oral): LD50 (rat) ≥ 2000 mg/kg bw. Reproduction toxicity: no data, but we (NIPH) performed a QSAR toxicity prediction, but judged the outcome as uncertain	No hazard statements provided. Claimed P&B (Su, 2019)
LCM-25 	825633-75-8	4-Butyl-4''-ethyl-2'-fluor-1,1':4',1''-terphenyl logKow= >5.7	≥ 1 to < 10	Acute (oral): LD50 (in vivo read-across) > 2000 mg/kg bw.	No hazard statements provided. Claimed P&B (Su, 2019)

LCM-28 (PFAS structure) 	524709-77-1	2',3,5-Trifluoro-4''-(trans-4-propylcyclohexyl)-4-trifluoromethoxy-[1,1';4',1'']terphenyl logKow= >6.5	≥ 1 to < 10	Acute (oral&dermal): LD50 (rat) > 2000 mg/kg bw. Repeated dose toxicity (rat oral, 28d): **liver, lymph node, and thymus toxicity** at 300 & 1000 mg/kg, but reversible effects (→NOAEL=1000 mg/kg).	No hazard statements provided. Claimed P&B (Su, 2019)
LCM-29 (PFAS structure) 	303186-36-9	4-[difluoro(3,4,5-trifluorophenoxy)methyl]-2',3,5-trifluoro-4''-propyl-1,1':4',1''-terphenyl logKow= >6.5	≥ 1 to < 10	Acute (oral&dermal): LD50 (rat) > 2000 mg/kg bw.	No hazard statements provided. Claimed P&B (Su, 2019)

NIPH
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