Proposal for development of hazard identification materials on *p,p′*-bisphenol chemicals, to support consideration for listing by the DARTIC in 2026

INTRODUCTION

In this document, we propose an approach to developing hazard identification materials to assist the Developmental and Reproductive Toxicant Identification Committee (DARTIC) in its consideration of *p,p′*-bisphenol chemicals for listing under Proposition 65 for reproductive toxicity. *p,p′*-Bisphenol chemicals include *p,p′*-bisphenols, and ethers and esters of *p,p′*-bisphenols. There are currently two *p,p′*-bisphenols on the Proposition 65 list for reproductive toxicity, bisphenol A (BPA) and bisphenol S (BPS). Information discussed below regarding other *p,p′*-bisphenol chemicals, including information on use, occurrence, and effects relevant to reproductive toxicity, suggests that a review of the evidence on the reproductive toxicity of these chemicals is warranted.

The scientific literature pertaining to the reproductive toxicity of *p,p′*-bisphenol chemicals is large, and growing. This poses a challenge in developing a hazard identification document on a large number of chemicals in 2026. We propose that rather than reviewing data for all possible outcomes within a developmental and reproductive toxicity (DART) endpoint (i.e., female reproductive toxicity, male reproductive toxicity, or developmental toxicity), we focus on a limited number of outcomes per endpoint. Our proposal presents an exploratory analysis used to select specific DART outcomes for inclusion in the hazard identification document.

We also propose to modify the scope and type of information provided in the document's tables summarizing individual study findings, while continuing to provide the DARTIC with copies of all the studies and other publications cited in the document. In presenting the data for the selected outcomes associated with a given endpoint, the level of detail provided for each study in the hazard identification document tables will be streamlined. Details of these proposed changes are described below.

OEHHA is seeking the DARTIC's advice and consultation on this proposal at their Oct. 9, 2025, meeting.

p,p'-BISPHENOL CHEMICALS

Structure and Definition:

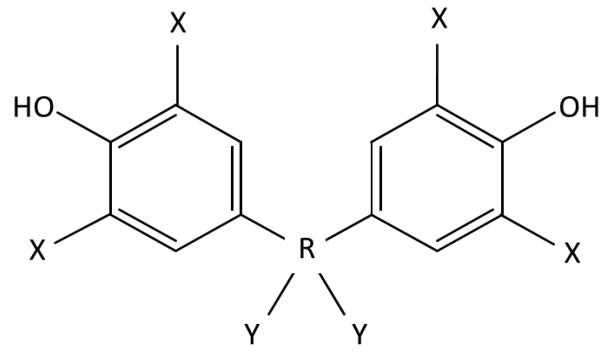

Figure 1. Representative structure of a *p,p'*-bisphenol (Adapted from (Kitamura et al. 2005)).

Legend:
R represents a bridging atom linking two phenol groups (i.e., carbon or sulfur atom)
X represents hydrogen or various substituents attached to a phenol group
Y represents hydrogen or various substituents attached to the bridge between two phenol groups, by either single or double bonds
For ethers of *p,p'*-bisphenols, the hydroxyl groups are replaced by hydrocarbon ether group(s).
For esters of *p,p'*-bisphenols the hydroxyl groups are replaced by hydrocarbon ester group(s).

As seen in Figure 1, *p,p'*-bisphenols have the basic structure of two phenol groups, with the hydroxyl groups at the *para* positions, joined by a carbon or sulfur bridge. Substituents attached to the phenolic rings, and the bridge can vary and can include alkyl groups or halogens. These compounds have high log K_{ow} values (i.e., log K_{ow} >1), a measure of hydrophobicity, making them fat soluble and persistent in the environment (OEHHA 2012).

As indicated in the legend to Figure 1, *p,p'*-bisphenol ethers have an ether bond (C-O-C) linking a hydrocarbon group with the six-carbon aromatic ring which has replaced one or more of the hydroxyl groups in the *para* position on the benzene ring. An example of a *p,p'*-bisphenol ether is tetrabromobisphenol A-bis(2,3-dibromo-2-methylpropyl ether) (TBBPA-DBMPE) (Figure 2). Diglycidyl ethers of *p,p'*-bisphenols have a basic bisphenol structure, with epoxypropyl ether groups in place of the hydroxyl groups, for example bisphenol A diglycidyl ether (BADGE) (Figure 3).

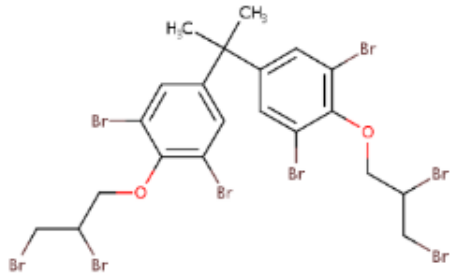

Figure 2. Chemical structure of Tetrabromobisphenol A bis(2,3-dibromopropyl) ether (TBBPA-DBPE). From CompTox Chemicals Dashboard

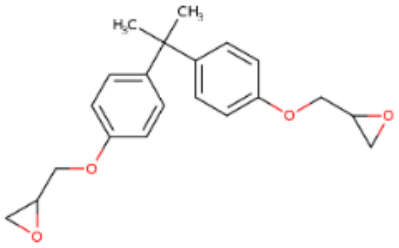

Figure 3. Chemical structure of Bisphenol A diglycidyl ether (BADGE). From CompTox Chemicals Dashboard

Table 1 lists *p,p'*-bisphenol chemicals with information relevant to reproductive toxicity that were identified in a preliminary search of the published literature.

Table 1. *p,p'*-Bisphenols and *p,p'*-bisphenol ethers with possible DART effects identified in a preliminary literature search.

Abbreviation in Figure 5	Name	Full name	CASRN*
3,3'-diClBPA	3,3'-Dichlorobisphenol A	4,4'-Isopropylidenebis[*o*-chlorophenol]	79-98-1
3-ClBPA	3-Chlorobisphenol A	2-(3-Chloro-4-hydroxyphenyl)-2-(4-hydroxyphenyl)propane	74192-35-1
BADGE	Bisphenol A diglycidyl ether	2,2-Bis[4-(glycidyloxy)phenyl]propane	1675-54-3
BHPF	Fluorene-9-bisphenol	9,9-Bis(4-hydroxyphenyl)fluorene	3236-71-3
BPA	Bisphenol A	4,4'-Isopropylidenediphenol	80-05-7
BPAF	Bisphenol AF	4,4'-[2,2,2-Trifluoro-1-(trifluoromethyl)ethylidene]diphenol	1478-61-1
BPAP	Bisphenol AP	4,4'-(1-Phenylethylidene)bisphenol	1571-75-1

Abbreviation in Figure 5	Name	Full name	CASRN*
BPB	Bisphenol B	4,4'-(1-Methylpropylidene)bisphenol	77-40-7
BPC	Bisphenol C	4,4'-(1-Methylethylidene)bis[2-methylphenol]	79-97-0
BPE	Bisphenol E	4,4'-Ethylidenebisphenol	2081-08-5
BPF	Bisphenol F	4,4'-Methylenediphenol	620-92-8
BPFL	Bisphenol FL	9,9-Bis(4-hydroxyphenyl)fluorene	3236-71-3
BPG	Bisphenol G	2,2-Bis(4-hydroxy-3-isopropylphenyl)propane	127-54-8
BPM	Bisphenol M	1,3-Bis[2-(4-hydroxyphenyl)-2-propyl]benzene	13595-25-0
BPP	Bisphenol P	4,4'-(1,4-Phenylenediisopropylidene)bisphenol	2167-51-3
BPS	Bisphenol S	4,4'-Sulphonyldiphenol	80-09-1
BPTMC	Bisphenol TMC	4,4'-(3,3,5-Trimethylcyclohexylidene)bisphenol	129188-99-4
BPY	Bisphenol Y	4,4'-(2-Pyridinylmethylene)bisphenol diacetate (ester)	603-50-9
BPZ	Bisphenol Z	4,4'-Cyclohexylidenebisphenol	843-55-0
TBBPA	Tetrabromobisphenol A	4,4'-(Propane-2,2-diyl)bis(2,6-dibromophenol)	79-94-7
TBBPA-(B)DBPE	Tetrabromobisphenol A bis(2,3-dibromopropyl) ether	2,2-Bis[3,5-dibromo-4-(2,3-dibromopropoxy)phenyl]propane	21850-44-2
TBBPA-DBMPE	tetrabromobisphenol A-bis(2,3-dibromo-2-methylpropyl ether)	1,1'-(Isopropylidene)bis(3,5-dibromo-4-(2,3-dibromo-2-methylpropoxy)benzene)	97416-84-7
TBBPA-DHEE	Tetrabromobisphenol A bis(2-hydroxyethyl) ether	2,2-Bis[3,5-dibromo-4-(2-hydroxyethoxy)phenyl]propane	4162-45-2
TBBPA-DME	tetrabromobisphenol A dimethyl ether	4,4'-Isopropylidenebis(2,6-dibromomethoxybenzene)	37853-61-5
TCBPA	Tetrachlorobisphenol A	4,4'-Isopropylidenebis(2,6-dichlorophenol)	79-95-8
TMBPA	Tetramethylbisphenol A	4,4'-(1-Methylethylidene)bis[2,6-dimethylphenol]	5613-46-7
TMBPF	Tetramethylbisphenol F	4,4'-Methylenebis(2,6-dimethylphenol)	226-378-9

*Chemical Abstracts Service Registry Number (CASRN) from PubChem web page: PubChem

Other agencies, including the European Chemicals Agency (ECHA), the National Toxicology Program (NTP), and the US Environmental Protection Agency (US EPA), have evaluated various groupings of bisphenols due to their human health and environmental hazards, including reproductive toxicity and identification as endocrine-disrupting chemicals (EDCs), their widespread use, the sizeable extent of the class, and the importance of preventing harmful substitutions. ECHA proposed restrictions on multiple bisphenols, including those that met the EDC definition (ECHA 2022). In a report published by NTP, a systematic review of the literature was performed for 24

structural or functional analogues of BPA and the data were assessed for structural and biological similarities among the BPA analogues with BPA or estradiol. NTP concluded that many of these chemicals may have endocrine activity *in vivo* (Pelch K et al. 2017). US EPA conducted a hazard assessment on BPA alternatives in thermal paper to inform selection of alternatives. Nineteen BPA alternatives were considered for human health hazard identification for reproductive and developmental endpoints with a discussion on endocrine disruption. The result was a semi-quantitative, screening-level comparison that produced a hazard designation system (US EPA 2015). Appendix A contains a table listing the bisphenols reviewed in each of these reports.

Uses and occurrence of *p,p′*-bisphenol chemicals

p,p′-Bisphenol chemicals are used for a variety of purposes including intermediates in the production of polymers, thermal papers, textiles, adhesives, and inks and coatings (ECHA 2021). Some *p,p′*-bisphenol chemicals are also used to make polycarbonate plastics, epoxy resins, paints and coatings, rubber products, and flame retardants (ECHA 2021; OEHHA 2012; US EPA 2025).

A number of *p,p′*-bisphenol chemicals have been detected in human biomonitoring studies, including in studies of Californians which detected BPA, BPS, bisphenol AF (BPAF), bisphenol AP (BPAP), bisphenol B (BPB), and bisphenol Z (BPZ) (Biomonitoring California 2025; Oh et al. 2024). BPA, bisphenol F (BPF), and BPS concentrations from Biomonitoring California studies are presented in Appendix B Table B.1.

In a preliminary literature review of *p,p′*-bisphenol chemicals and DART outcomes,16 *p,p′*-bisphenol chemicals were identified as having been measured and detected in study populations from 14 countries spanning three continents. Figure 4 shows the distributions of detection frequencies reported in 85 publications for these 16 *p,p′*-bisphenol chemicals. Across studies, the median detection frequencies for most of these *p,p′*-bisphenol chemicals were between 45–60%, with high variability observed across studies.

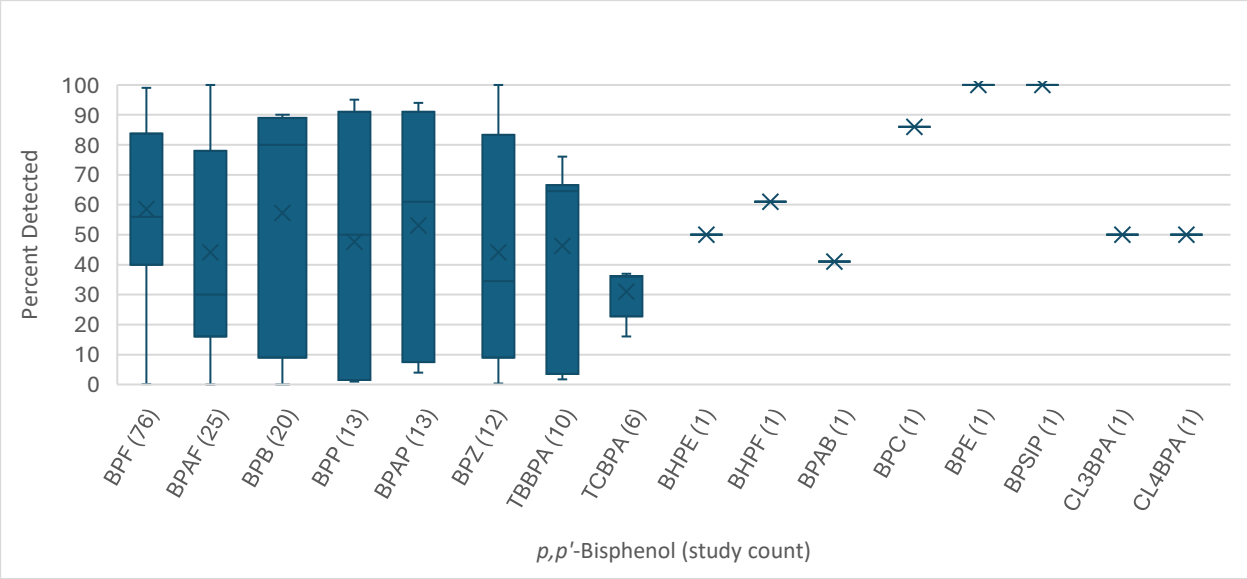

Figure 4. Range of detection frequencies in epidemiologic studies of *p,p′*-bisphenol chemicals and DART outcomes (n=85) ordered by the number of studies that reported detectable levels of each *p,p′*-bisphenol chemical. Note that some studies contained multiple *p,p′*-bisphenol chemicals.

Data used to develop this proposal

In order to select outcomes, OEHHA conducted an exploratory literature search using search terms for select *p,p′*-bisphenol chemicals together with the same DART outcome search terms used in our recent hazard identification documents on BPS (OEHHA 2023, 2024, 2025). For this preliminary look at the literature, we carried out the literature search in PubMed only. We will conduct a comprehensive literature search for the proposed hazard identification document. This literature search may identify other *p,p′*-bisphenol chemicals to include.

OEHHA conducted a title and abstract-level screen of the studies and tagged the studies by types of DART outcomes assessed. Based on a review of the study abstracts only, we counted studies that reported significant effects for each *p,p′*-bisphenol chemical, by outcome. Counts of studies that reported significant effects in human, mammalian, and non-mammalian studies were visualized via heat maps (Figure 5). Counts are specific to an outcome or *p,p′*-bisphenol chemical, not unique studies. Many studies assessed multiple outcomes and more than one *p,p′*-bisphenol chemical.

Because we carried out an exploratory literature search and reviewed study titles and abstracts only, these data should be considered preliminary. Study findings that were reported in full-text manuscripts but not reported in the study abstracts may not be

represented. Further, the counts of studies with significant effects do not consider study quality, direction of effects, or magnitude of associations observed.

Figure 5. Human (A), mammalian (B), and non-mammalian (C) studies with significant findings by *p,p'*-bisphenol chemical and DART endpoint and outcome

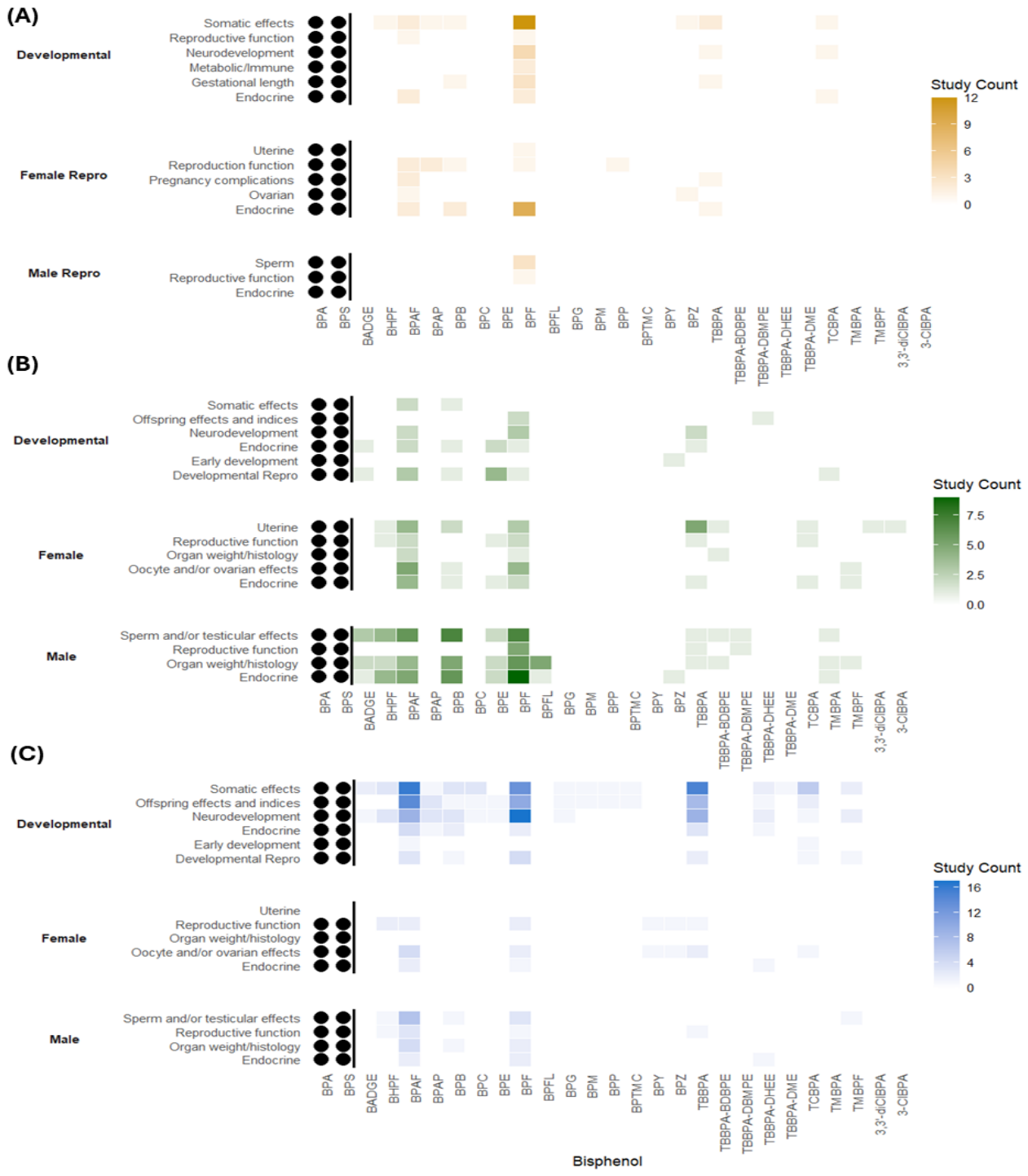

Figure 5 caption: Study counts were derived by abstract review only. The literature search did not include search terms for BPA and BPS, thus those chemicals are excluded from the heatmap. For reference, circular symbols (●) for BPA and BPS are used to represent the presence of any data linking those chemicals with each outcome. For human studies, somatic effects include outcomes such as birth size, infant growth, and birth defects. For mammalian and non-mammalian studies, male reproductive categories of sperm and/or testicular effects and organ weight/histology are not mutually exclusive categories.

Based on an initial assessment of Figure 5, we are proposing to evaluate the following outcomes to be tabulated and discussed for each endpoint:

1. Female reproductive toxicity endpoint: oocyte and ovarian effects, uterine effects, endocrine effects.
2. Male reproductive toxicity endpoint: sperm and testicular effects, endocrine effects.
3. Developmental toxicity endpoint: somatic effects, neurodevelopmental effects, effects on offspring reproductive development, and endocrine effects.

Along with the hazard identification document, OEHHA will provide the DARTIC with all references (PDFs) cited in that document so members can review all outcomes in the literature, including those not explicitly focused on in the hazard identification document.

SUMMARY TABLES OF STUDIES

For the hazard identification document on *p,p'*-bisphenol chemicals, OEHHA plans to prepare streamlined summary tables that focus on selected DART outcomes for each reproductive toxicity endpoint. Examples of these proposed tables are provided below.

Female reproductive toxicity

Studies in Humans

Table 1: Epidemiologic studies of female reproductive toxicity

Reference; study location, period, design, sample	Exposure Matrix and *p,p'*-Bisphenol chemical(s)	LOD, ng/mL	Detection Rate	Median Concentration ng/mL	Outcome	Results	Covariates
Huang et al. 2022 China 2015-2018 Cohort	Urine Spot BPA BPB BPF BPS TBBPA	 0.193 0.232 0.507 0.046 0.454	 99% 90% 64% 86% 65%	 1.99 0.23 0.61 0.10 0.47	**Endocrine** Serum thyroid hormone levels: T3, T4, FT3, FT4, TSH	**Endocrine** **BPA** associated with higher FT3: high vs. low: 0.2, 95%CI: -5.5, 6.3 med vs. low: **6.3, 95% CI: 0.4, 12.5** **BPB** associated with lower FT4: per unit increase: **-10.5, 95% CI: -17.5, -2.8** associated with lower T4: per unit increase: **-10.9, 95% CI: -19.1, -1.8** **BPF** associated with higher TSH: per unit increase: **70.8, 95% CI: 0.2, 191.1** **BPS** associated with lower T3, high vs. low: -4.8, 95% CI: -12.4, 3.5 med vs. low: **-10.9, 95% CI: -18.2, -3.0** **TBBPA** associated with lower T3: high vs. low: -3.1, 95% CI: -10.7, 5.1 med vs. low: **-8.3, 95% CI: -15.8, -0.01**	Maternal age, pre-pregnancy BMI, drinking before pregnancy, passive smoking during pregnancy, gravidity, parity, and fetus sex

Triiodothyronine = T3, thyroxine = T4, free triiodothyronine = FT3, free thyroxine = FT4, thyroid-stimulating hormone = TSH

Studies in Animals

Table 2: Evidence on female reproductive toxicity in animal models

Study Design	*p,p'*-Bisphenol chemical(s)	Treatment period	Outcomes assessed	Major Findings
Zhu et al. 2025 **Pregnant female SD rats**, 11-weeks-old, n = 6 dams per treatment group	**BPAF** 50 or 100 mg/kg-day	In corn oil (vehicle control) via gavage from GD 3 to GD 21 Assessed on PND 21	**Oocyte/ovary** Gonad weights and gonad histopathology at high dose only **Endocrine** (plasma levels) Testosterone E2 FSH LH	**Oocyte/ovary** Increased vacuolization in follicular antrum and decreased number of follicles No effect on relative ovary weight **Endocrine** Increased E2 and LH at 100 mg/kg-day, and No effects on testosterone or FSH
Huang et al. 2017 **Marine medaka** (*Oryzias melastigma*) 15 fish, n = 3 replicates for each treatment group	**BPA** **TBBPA** **TCBPA** 0.05 or 0.2 mg/L	In 0.2% DMSO (vehicle control) from hatching to 4 months	**Oocyte/ovary** Oogenesis Gonadosomatic index (GSI) **Endocrine** E2 levels – whole body homogenate	**Oocyte/ovary** Oogenesis Decreased mature spawning follicles with cortical alveolar, early vitellogenic, and perinucleolar phase oocytes as major cell types with **BPA** compared to mature spawning follicles and early vitellogenic oocytes as major cell types GSI: Decreased at 0.05 and 0.2 mg/L **BPA** and at 0.2 mg/L **TCBPA** **Endocrine** Decreased E2 at 0.05 and 0.2 mg/L **BPA**

Male reproductive toxicity

Studies in Humans

Table 3: Epidemiologic studies of male reproductive toxicity

Reference; study location, period, design, sample	Exposure Matrix *p,p'*-Bisphenol Chemical(s)	LOD, ng/mL	Detection Rate	Median Concentration ng/mL	Outcome	Results	Covariates
Jeseta et al. 2024 Czech Republic, 2019-2021 Cross-sectional n = 30	Seminal plasma BPA BPS BPF BPAF	 0.004 0.002 0.001 0.0002	 76.5 77.4 14.4 23.9	 0.061 0.024 0.00071 0.00049	**Sperm** Ejaculate volume (mL) Sperm concentration (mil/mL) Progressive motility (%) Sperm morphology (%) Total sperm count (mil) DNA fragmentation index % = (fragmented spermatozoa + degenerated spermatozoa/total spermatozoa counted) x 100	**Sperm** Per 10-fold increase in continuous BP: **BPA** **Sperm progressive motility β=-0.167 (p=0.005); sperm morphology β= -0.174 (p=0.001)** **BPS** **Ejaculate volume β= -0.09 (p = 0.013); total sperm count β = -0.17 (p = 0.018)** **BPF** **DNA integrity β=-0.129 (p=0.014)*** BPAF no associations *The BPF detection rate was low and the significant association with DNA integrity was not observed when analyzing a categorical (above vs. below limit of quantification) BPF exposure variable, so authors caution that it might be a "false-positive result affected by censored values imputation"	Age, BMI, ejaculation abstinence, smoking, reactive oxygen species

Studies in Animals

Table 4: Evidence on male reproductive toxicity in animal models

Study Design	*p,p'*-Bisphenol Chemical(s)	Treatment period	Outcomes assessed	Major Findings
Zhu et al. 2025 **Pregnant female SD rats**, 11-weeks-old, n = 6 dams per treatment group	**BPAF** 50 or 100 mg/kg-day	In corn oil (vehicle control) via gavage from GD 3 to GD 21 Assessed on PND 21	**Sperm/testis** Gonad weights (100 mg/kg-day) Gonad histopathology (100 mg/kg-day) transcriptomics **Endocrine** (plasma) Testosterone E2 LH FSH	**Sperm/testis** Decreased relative testis weight and Dissolution of interstitial cells and decreased primary spermatocytes Enrichment of two pathways related to male reproductive disorders Decreased testosterone biosynthesis-related genes at 50 and/or 100 mg/kg/day **Endocrine** Decreased testosterone at both doses, Increased LH at 100 mg/kg-day, and No effect on E2 or FSH
Yang et al. 2017 Wildtype zebrafish, AB strain, four-months-old	**BPF** 0.001, 0.01, 0.1, or 1 mg/L	In 0.1% DMSO (vehicle control) for 21 days	**Sperm/testis** Germline cell distribution (reported for 0.1 and 1 mg/L). GSI Testis structure **Endocrine** (Whole body homogenate) Testosterone E2 Testosterone/E2 ratio	**Sperm/testis** Decreased spermatogonia and spermatocytes Increased spermatids Decreased GSI at 1 mg/L Increased testis interstitial space at 1 mg/L **Endocrine** Decreased testosterone at ≥ 0.01 mg/L Increased E2 at ≥ 0.1 mg/L Decreased testosterone/E2 ratio at all concentrations Altered expression of HPG axis-related genes

Developmental toxicity

Studies in Humans

Table 5*:* Epidemiologic studies of developmental toxicity

Reference; study location, period, design, sample	Exposure Matrix *p,p'*-Bisphenol chemical(s)	LOD ng/mL	Detection Rate	Median Concentration ng/mL	Outcome	Results	Covariates
Mustieles et al. 2023 France, 2014-2017 Prospective Cohort Study n = 40	Urine spot BPA BPS BPF BPB BPAF	 0.04 0.10 NR NR NR	 98-99 26-28 < 5 < 5 < 5	 1.83-2.09 < LOD NR NR NR	**Neurodevelopment** Child social behavior and autistic traits using the Social Responsiveness Scale, age 3 Five subscales: social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviors	**Neurodevelopment** BPF, BPB, and BPAF were measured in < 5% of samples and excluded from analysis Per unit increase in continuous BP: BPA no associations **BPS** **Total score, β: 3.82 (95% CI: 0.94, 6.70); social awareness, β: 0.89 (95% CI: 0.30, 1.48); social cognition, β: 1.02 (95% CI: 0.30, 1.74); social communication, β: 1.25 (95% CI: 0.15, 2.35)**	Maternal age, employment, breastfeeding, multivitamin intake, pre-pregnancy BMI, education, anxiety/depression score at TM3, active smoking, passive tobacco exposure, parity, mode of childcare, family environment, child sex, and child age at outcome evaluation

Studies in Animals

Table 6: Evidence on developmental toxicity in animal models

Study Design	*p,p'*-Bisphenol chemical(s)	Treatment period	Outcomes assessed	Major Findings
Abdallah et al. 2023 **Pregnant NMRI mice**	**BADGE** 10 µM **BPAF** 10 µM	In drinking water From GD 10.5 to 18.5. Female gonads from fetuses, neonates (PND 8), or adults (3-months-old)	**Female reproductive development** Meiotic phase distribution Chromosome segregation Follicle stages and count **Ovarian effects** Transcriptomics	**Female reproductive development** Effects observed for both BADGE and BPAF Altered meiotic phase stage distribution Altered chromosome segregation Increased reciprocal chromosomal exchanges in prophase I at GD18.5 Increased missegregation in meiotic metaphase I and aneuploid oocytes in meiotic metaphase II at 3 months Follicle stages and count: Increased multi-oocyte follicles at PND 8 and 3 months **Ovarian effects** DEGs related to meiosis- and germ and stem cell differentiation
Bai et al. 2023 **Zebrafish (WT, AB strain)** 20 zebrafish per treatment, n = 3	**[µM]** **BPA:** 0.2, 2, 20 **BPF:** 0.3, 3, 30 **BPS:** 1, 10, 100 The following chemicals were only evaluated for nearest neighbor and interindividual distances: **BPAF:** 0.05, 0.5, 5 **BPAP:** 0.04, 0.4, 4 **BPB:** 0.1, 1, 10 **BPC:** 0.05, 0.5, 5 **BPE:** 0.3, 3, 30 **BPF:** 0.3, 3, 30 **BPZ:** 0.07, 0.7, 7	In 0.1% DMSO (control) From 8 -108 hpf	**Somatic effects** Only for BPA, BPF and BPS **Neurodevelopment** Spontaneous movement (24 hpf) Swimming distance (5 dpf) Light/dark activity (10 dpf) Shoaling behavior (11 dpf; nearest neighbor distance, interindividual distance) Social contact (13 dpf) Neurogenesis (108 hpf; 2 µM BPA, 3 µM BPF, 1 µM BPS)	**Somatic effects** Increased intraocular distance (BPA, BPF, BPS) Increased lower jaw length (BPA, BPF, BPS) Increased ceratohyal cartilage length (BPA, BPF, BPS) No effects on head size **Neurodevelopment** BPA, BPS and BPF had an increase in spontaneous movement, dark period swimming distance, Increase time in light area, and decreased light/dark crossings Increased light period swimming distance BPA (0.2 and 2 µM) and all BPS concentrations Decreased light period swimming distance at 20 µM BPA and 0.3 µM BPF Increased nearest neighbor distance (BPB, BPC, BPF, BPS, BPAF, and BPAP) Increased interindividual distance (BPA,BPC, BPF, BPS, BPAF, and BPAP) Decreased time in contact (BPA, BPS, and at 0.3 & 3 µM BPF) Increased time in contact at 30 µM BPF Accelerated neurogenesis and increased neural stem cell proliferation

Study Design	*p,p'*-Bisphenol chemical(s)	Treatment period	Outcomes assessed	Major Findings
Huang et al. 2017 **Marine medaka** (*Oryzias melastigma*) 15 fish, n = 3 replicates for each treatment group	**BPA** **TBBPA** **TCBPA** 0.05, 0.2, 0.8, or 1.6 mg/L	In 0.2% DMSO (vehicle control) from 2 dpf up to 21 dpf	**Somatic effects** Heart rate (6 dpf)	**Somatic effects** Increased heart rate at all concentrations for BPA and TCBPA and ≥ 0.8 mg/L TBBPA
Kaiglová et al. 2025 ***C. elegans* (strain not specified)** Sample sizes not reported	**BPA** **BPAF** **BPF** **BPS** 0.5, 1, or 5 µM	In 10% ethanol (vehicle control), for four hours from embryo stage	**Somatic effects** Body length (18 hours post exposure) **Neurodevelopment** Anterior touch– habituation (48 hours post exposure, non-associative learning)	**Somatic effects** Decreased body length at all BPA concentrations, at ≥ 5 µM BPAF, and 5 µM BPS No effects with BPF **Neurodevelopment** Increased number of touches required for habituation at all concentrations for all BPs

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APPENDIX A: BISPHENOLS ASSESSED BY OTHER AGENCIES

Table A.1. Bisphenols grouped for evaluation by ECHA, NTP, and US EPA[a].

Chemical	ECHA	NTP	US EPA
BPA*	X		X
BPS*	X	X	X
2,4-BPS			X
BPB*	X	X	
4,4-BPF*	X	X	X
2,2-BPF		X	
BPAF*	X	X	
BPAP*		X	X
BPP*		X	
BPZ*		X	
BPE*		X	
TMBPA		X	
BDP		X	
BPC*		X	X
BPS-MAE		X	X
BPS-MPE			X
Pergafast 201		X	X
BPPH*		X	
D-8		X	X
D-90			X
DD-70*			X
MBHA*			X
BisOPP-A*			X
PHBB			X
TGSA*			X
BTUM			X
UU			X

[a] ECHA 2022, NTP 2017 (Pelch et al., 2017), US EPA 2015.

* *p,p'*-Bisphenols. The bisphenols in this table include, but are not limited to, *p,p'*-bisphenols.

APPENDIX B: BIOMONITORING CALIFORNIA DATA

Table B.1. *p,p'*-Bisphenol urine concentrations (µg/L) in studies of California residents conducted by Biomonitoring California

Study Name, year[1]	Bisphenol	Sampled Group	Geometric mean	50th Percentile	90th Percentile	Number of Participants	Detection Frequency
MIEEP, 2010-11	**BPA**	Pregnant women	1.25 (95% CI: 0.984-1.58)	1.27	4.85	89	NA
FOX, 2010-11	**BPA**	Firefighters	1.58 (95% CI:1.25-1.99)	1.53	11.9 (95th)	101	94.1%
BEST-1, 2011-12	**BPA**	Adults	1.40 (95% CI: 1.08-1.80)	1.31	13.3 (95th)	109	89.9%
BEST-2, 2013	**BPA**	Adults	1.33 (95% CI: 1.05-1.69)	1.52	5.66 (95th)	218	97.4%
CARE-LA, 2018	**BPA**	Women	Not calculated	< LOD	1.96	60	46.7%
	BPF	Women	Not calculated	< LOD	0.86	60	23.3%
	BPS	Women	0.38 (95% CI: 0.27-0.54)	0.342	2.42	60	76.7%
CARE-2, 2019	**BPA**	Adults	0.503 (95% CI: 0.419-0.603)	0.466	3.19 (95th)	151	69.5%
	BPS	Adults	Not calculated	0.233	2.25 (95th)	151	64.9%
CARE-3, 2020	**BPA**	Adults	0.287 (95% CI: 0.233-0.352)	0.281	0.895	90	82.2%
	BPF	Adults	Not calculated	< LOD	2.03	90	41.1%
	BPS	Adults	Not calculated	0.288	2.85	90	64.4%

[1] Maternal and Infant Environmental Exposure Project (MIEEP). Sample collection 2010-2011; Firefighter Occupational Exposures (FOX) Project. Sample collection 2010-2011; Biomonitoring Exposures Study (BEST)-1.Pilot (BEST-1). Sample collection 2011-2012; BEST-2. Expanded (BEST-2). Sample collection 2013; California Regional Exposure Study (CARE), Los Angeles County (CARE-LA). Sample collection in 2018; CARE, Region 2 (CARE-2). Sample collection in 2019; CARE Region 3 (CARE-3). Sample collection in 2020.

*Geometric mean not calculated when the chemical was found in <65% of samples; CI: confidence interval; µg/L: microgram per liter.

Further information and data available at **https://biomonitoring.ca.gov/** (Biomonitoring California 2025).