Potential Expansion of the Existing Designated Chemical Group "Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs)" to "Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs) and Other Substances with Carbon-Fluorine Bonds"

Rescheduled to November 6, 2023

~~August 21, 2023~~ Meeting of the Scientific Guidance Panel
Biomonitoring California[1]

Introduction

Perfluoroalkyl and polyfluoroalkyl substances (PFASs) as defined by Buck et al. (2011) were added to Biomonitoring California's list of designated chemicals at the March 2015 Scientific Guidance Panel (SGP) meeting. At the November 2021 SGP meeting, the Panel requested a report back on the Program's current definition of PFASs to be considered at a future meeting. In response, Biomonitoring California staff presented a review of the Buck et al. (2011) definition at the March 2022 SGP meeting and obtained input from the Panel and the public on next steps for this set of chemicals. Proposed next steps were to evaluate additional definitions and consider revising or expanding the current PFAS group on the lists of designated and priority chemicals.

As an interim step, Biomonitoring California revised the footnote on the lists of designated and priority chemicals defining PFASs to reflect the updated interpretation of Buck et al. (2011) following the March 2022 meeting. The revised footnote reads as follows:

> "For the description of PFASs and example members of this class, refer to Buck et al. (2011). (Integr Environ Assess Manag 7[4]:513–541; link to free article: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3214619/)."

Based on input from the Panel, public, and further research, Biomonitoring California staff have prepared this document for the Panel to consider with regard to the potential expansion of the existing designated chemical group "Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs)[2]" to "Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs)[2] and Other Substances with Carbon-Fluorine Bonds[3]."

If the Panel were to recommend expanding the existing chemical group on the list of designated chemicals for Biomonitoring California, the Program could include any member of this expanded chemical group in future biomonitoring studies.

---

[1] California Environmental Contaminant Biomonitoring Program, codified at Health and Safety Code section 105440 et seq.
[2] For the description of PFASs and example members of this class, refer to Buck et al. (2011). (Integr Environ Assess Manag 7[4]:513–541; link to free article: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3214619/)
[3] Includes substances with at least one carbon-fluorine bond.

Reason for Expansion of Chemical Group

As discussed at the March 22, 2022, SGP meeting, the current designated chemical group “Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs)”, as defined by Buck et al. (2011), does not cover several fluorinated chemicals of concern that are included under the definitions used by other entities.

The expansion of the existing designated chemical group aims to capture substances with at least one carbon-fluorine (C-F) bond that are not included in the Program’s current PFASs designated chemical group, and to support Biomonitoring California activities and priorities. The C-F bond is one of the strongest known covalent bonds, and the C-F bonds in PFASs are recognized as key features that impart chemical and thermal stability and persistence[4]. Listing of this expanded group would give the Program the flexibility to choose to biomonitor additional substances with C-F bonds of potential health concern that would be appropriate to measure in response to market shifts in use. Although the Program can measure any chemical in the group, it does not mean that they must or will. This approach has been routinely used by Biomonitoring California to provide broad flexibility to identify potential emerging chemicals of concern.

Chemical Identity and Example Structures

Based on input from the Panel, public, and other stakeholders, Biomonitoring California has chosen to evaluate and compare three commonly cited PFASs definitions: Buck et al. (2011), Organization for Economic Cooperation and Development (OECD) (2021), and California Senate Bill (SB) 1044. As demonstrated in Tables 1-4 below, there are inconsistencies in the PFASs that are covered under each of these definitions. The tables below show some examples of chemicals of potential concern with at least one C-F bond that would be captured under the proposed expanded designated chemical group “PFASs and Other Substances with Carbon-Fluorine Bonds” and indicate whether these chemicals are considered to be PFASs by Buck et al. (2011), OECD (2021), and SB 1044.

- Table 1 shows examples of polymers with C-F bonds that are considered to be PFASs by Buck et al. (2011), OECD (2021), and SB 1044.
- Table 2 shows an example of a polymer with C-F bonds that is considered to be a PFAS by Buck et al. 2011, but not by OECD (2021) or SB 1044.
- Table 3 shows examples of chemicals with C-F bonds that are considered to be PFASs by OECD (2021) and SB 1044, but not by Buck et al. (2011).
- Table 4 shows example chemicals with C-F bonds that are NOT considered to be PFASs by Buck et al. (2011), OECD (2021), or SB 1044.

[4] Refer to the March 2015 background document for additional information on the chemical properties and use of perfluoroalkyl and polyfluoroalkyl substances (PFASs).

Table 1. Selected examples of polymers with C-F bonds. All examples are considered to be PFASs by Buck et al. (2011), OECD (2021), and SB 1044.

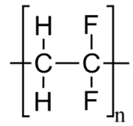
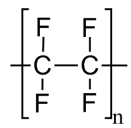
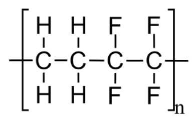
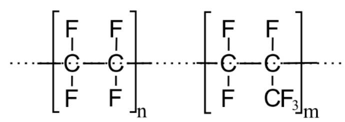
Polymers with C-F bonds	Structure
PVDF (polyvinylidene fluoride or polyvinylidene difluoride) CAS#: 24937-79-9	
PTFE (polytetrafluoroethylene) CAS#: 9002-84-0	
ETFE (ethylene tetrafluoroethylene) CAS#: 25038-71-5, 68258-85-5	
FEP (fluorinated ethylene propylene) CAS#: 25067-11-2	

Table 2. An example of a polymer with C-F bonds, which is considered to be a PFAS by Buck et al. 2011, but not by OECD (2021) or SB 1044.

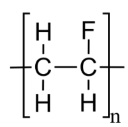
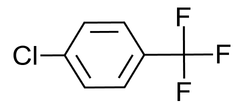
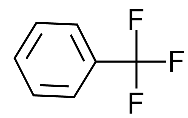
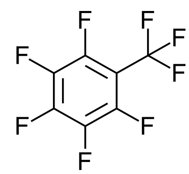
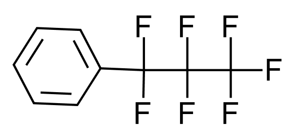
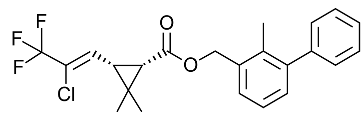
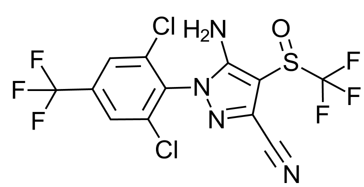
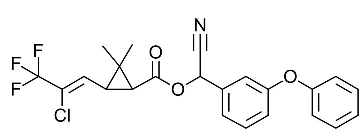
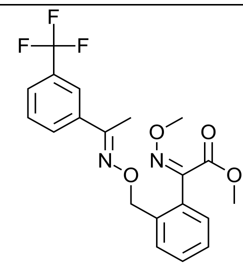
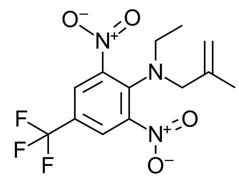
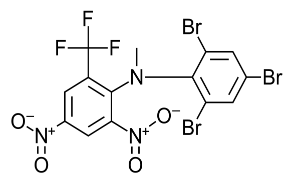
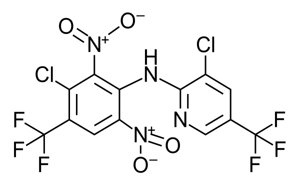
Polymer with C-F bonds	Structure
PVF (polyvinyl fluoride) CAS#: 24981-14-4	

Table 3. Selected examples of chemicals* with C-F bonds considered to be PFASs by OECD (2021) and SB 1044, but not Buck et al. (2011).

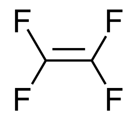
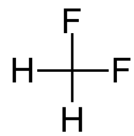
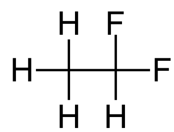
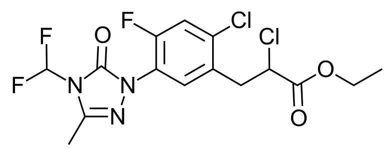
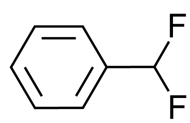
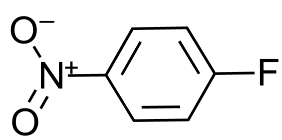
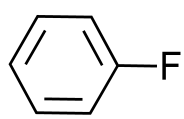
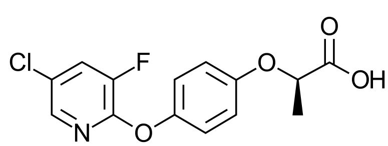
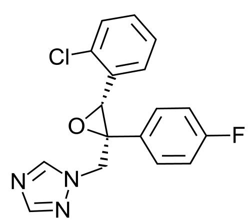
Chemicals with C-F bonds	Structure
PCBTF (parachlorobenzotrifluoride) CAS#: 98-56-6	
Benzotrifluoride (trifluoromethylbenzene) CAS#: 98-08-8	
Perfluorotoluene (octafluorotoluene) CAS#: 434-64-0	
(Perfluoropropyl)benzene CAS#: 378-98-3	
Bifenthrin[5] CAS#: 82657-04-3	
Fipronil[5] CAS#: 120068-37-3	
Cyhalothrin (including *lambda*- and *gamma*-)[5] CAS#: 68085-85-8	

[5] Already included on Biomonitoring California's designated chemical list for another reason (i.e., under "Pesticides").

Chemicals with C-F bonds	**Structure**
Trifloxystrobin CAS#: 141517-21-7	
Ethalfluralin CAS#: 55283-68-6	
Bromethalin CAS#: 63333-35-7	
Fluazinam CAS#: 79622-59-6	

* Chemicals that are not in the current “PFASs” designated chemical group, but which would be included in the potential expansion to “PFASs and other substances with carbon-fluorine bonds.”

Table 4. Selected examples of chemicals* with C-F bonds that are not considered to be PFASs by Buck et al. (2011), OECD (2021), or SB 1044.

Chemicals with C-F Bonds	Structure
Tetrafluoroethylene CAS#: 116-14-3	
Difluoromethane CAS#: 75-10-5	
1,1-Difluoroethane CAS#: 75-37-6	
Carfentrazone-ethyl CAS#: 128639-02-1	
(Difluoromethyl)benzene CAS#: 455-31-2	
1-Fluoro-4-nitrobenzene CAS#: 350-46-9	
Fluorobenzene CAS#: 462-06-6	
Clodinafop CAS#: 114420-56-3	
Epoxiconazole CAS#: 133855-98-8	

* Chemicals that are not in the current “PFASs” designated chemical group, but which would be included in the potential expansion to “PFASs and other substances with carbon-fluorine bonds.”

Expanding the Existing Designated Chemical Group Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs)

The SGP uses the criteria listed below to evaluate potential designated chemicals (see the SB 1379 legislation for a complete description of the criteria):

- Exposure or potential exposure.
- Known or suspected health effects.
- Need to assess the efficacy of public health actions to reduce exposure to a chemical.
- Availability of a biomonitoring analytical method.
- Availability of adequate biospecimen samples (for example, serum, plasma, or urine samples).
- Incremental analytical cost to perform the biomonitoring analysis for the chemical.

Tables 5 through 7 summarize selected references on exposure or potential exposures, known or suspected health effects, and analytical considerations for example substances that would fall under the potential expansion of the designated chemical group “PFASs” to “PFASs and other substances with carbon-fluorine bonds.” These are select examples from substances included in Tables 3 and 4.

Table 5. Selected references on the exposure potential of PFASs and other substances with C-F bonds.

Chemical	Exposure or potential exposure	References
PFASs	• PFASs (i.e., the existing designated chemical group described by Buck et al. (2011)). A number of PFASs have been detected in serum and urine by Biomonitoring California and the Centers for Disease Control and Prevention (CDC).	OEHHA (2015a, 2015b)
PCBTF*	• PCBTF uses include as a solvent in solvent-borne products such as sealers, stains, paints, inks, and high-solids coatings, and for metal cleaning. Total import in the United States (US) was 5,000 to 25,000 tons in 2019. • The general public in California may be exposed from the use of products that contain PCBTF, and from contact with groundwater, soil or air contaminated with the chemical. • The South Coast Air Quality Management District (SCAQMD) reports that use of PCBTF increased from 2005 to 2014 in California. • PCBTF can be found in workplace air (one study measured geometric mean 2.0 ppm in vehicle manufacturing plants and 0.8 ppm in paint manufacturing plants).	IARC (2020) Lee et al.(2015); OEHHA (2020); Stockwell et al. (2021)
Benzotrifluoride*	• Benzotrifluoride is used as a solvent in preparation of dyes and pesticides, and as an intermediate for pharmaceuticals. It was detected in groundwater used for drinking water in Italy as a result of improper waste disposal practices. After 40 years from the contamination, benzotrifluoride was still detected in the examined groundwater system.	Carli et al. (1983); Lava et al. (2021)
Difluoromethane*	• Difluoromethane is used as a refrigerant and to make other chemicals. Its atmospheric concentration has been increasing since 2009.	Scaranto et al. (2015)
1,1-Difluoroethane*	• 1,1-Difluoroethane is used as a refrigerant, propellant, foam expansion agent, and a chemical intermediate to make pesticides and consumer products such as cleaning products and air fresheners.	Custer et al. (2020)

Chemical	Exposure or potential exposure	References
Bifenthrin[5]*	• Bifenthrin is a pyrethroid insecticide used on numerous crops, in greenhouses, and buildings to control insects such as ants, drywood termites, and silverfish. In 2020, 307,581 pounds of bifenthrin was used in California. Indoor use may result in higher occupational exposures than outdoor use. Dietary exposure may occur through its use on food crops, and the US Environmental Protection Agency (EPA) has established tolerances for bifenthrin on several types of fruits and vegetables. • In 2006, bifenthrin was found in dust samples collected from low-income farmworker homes in Salinas, CA and urban homes in Oakland, CA at 23.9 and 2120 ng/g, respectively. • Bifenthrin and other pyrethroid pesticides were found in wastewater from the Sacramento, CA area with a combined concentration of 200-500 ng/L.	CDPR (1997, 2020); Federal Register (2021) Quirós-Alcalá et al. (2011) Weston et al. (2013); Weston et al. (2005)
Fipronil[5]*	• Fipronil is an insecticide used to control ants, beetles, cockroaches, fleas, ticks, termites, mole crickets, thrips, rootworms, weevils, and other insects and 19,710 pounds were used in California in 2020. The US EPA has established tolerances on several types of fruits and vegetables. • Exposure pathways include dietary exposure from residues on food and contamination of drinking water, and dermal exposure from fipronil's use in flea and tick spray products. • Fipronil sulfone, a metabolite of fipronil, has been detected in serum of some North Carolina residents who had no known exposure to fipronil or other pesticides. This fipronil metabolite was detected in 25% of the study subjects, at concentrations ranging from 0.1 to 4 ng/ml. • Fipronil sulfone was also detected in cord blood samples collected in China between February 2017 and January 2021 at levels ranging from 0.04 to 2.98 ng/ml.	CDPR (2020, 2023); Federal Register (2007b) McMahen et al. (2015) Xia et al. (2022)

Chemical	Exposure or potential exposure	References
Cyhalothrin[5]*	• Cyhalothrin is a restricted use insecticide used to control various pests on both agricultural sites (alfalfa, pistachio, lettuce, tomatoes) and non-agricultural sites, including in and around buildings and structures. In 2020, 369 pounds of cyhalothrin were used in California. Dietary exposure may occur through its use on crops, and the US EPA has established tolerances on several types of fruits and vegetables. • Cyhalothrin residues were detected in dislodgeable foliar residue (DFR) samples on grape leaves in California. Subsequent investigation confirmed that the cyhalothrin product, which was not registered for use on grapes, was mistakenly mixed and applied at 35 times the highest legal rate for any crop. • Cyhalothrin residues were detected in almost all tested vegetables and fruits collected between July 2020 and June 2021 from farmers' markets in Egypt. Spinach had the highest levels, in the range of 340-521 µg/kg.	CDPR (2020); Federal Register (2007a); Spencer and O'Malley (2006); El-Sheikh et al. (2022)
Trifloxystrobin*	• Trifloxystrobin is a fungicide used on numerous crops and in greenhouses. It is reported that 90,601 pounds of trifloxystrobin was used in California in 2020. Occupational and dietary exposure may occur through its use on food crops, and the US EPA has established tolerances on several types of fruits and vegetables.	CDPR (2020); Federal Register (2023b)
Ethalfluralin*	• Ethalfluralin is an herbicide used on several grains such as soybeans, dry beans, and sunflower seeds. It is reported that 35,979 pounds of ethalfluralin was used in California in 2020. Occupational and dietary exposure may occur through its use on crops, and the US EPA has established tolerances on several types of crops.	CDPR (2020); Federal Register (2023a)
Bromethalin*	• Bromethalin is a rodenticide. It was detected in four feral parrots that were poisoned in the Telegraph Hill area of San Francisco, CA. The maximum levels of bromethalin measured in feces, liver, and brain samples were 18.37, 10.84, and 11.91 µg/g, respectively.	Van Sant et al. (2019)
Epoxiconazole*	• Epoxiconazole is a fungicide. It is not registered for use in the US, but it is used in other countries. US EPA has established import tolerances for epoxiconazole (e.g., for bananas).	Federal Register (2006)

* Chemicals that are not in the current "PFASs" designated chemical group, but which would be included in the potential expansion to "PFASs and other substances with carbon-fluorine bonds."

Table 6. Selected references on the known or suspected health effects of PFASs and other substances with C-F bonds.

Chemical	Known or suspected health effects	References
PFASs	• Perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), and perfluorononanoic acid (PFNA) and its salts are on the Proposition 65 list as causing reproductive toxicity, and PFOA and PFOS and its salts and transformation and degradation precursors are listed as causing cancer.	OEHHA (2023a)
	• The US EPA and California Environmental Protection Agency (CalEPA) have identified a number of additional PFASs as posing health hazards such as perfluorodecanoic acid (PFDA), perfluorohexanesulfonic acid (PFHxS), perfluorobutane sulfonic acid (PFBS), perfluorononanoic acid (PFNA), and perfluoroundecanoic acid (PFUnDA) and their salts.	OEHHA (2015b); OEHHA (2015a)
	• The California notification levels for PFOA, PFOS, PFBS, and PFHxS in drinking water are recommended at 0.0051, 0.0065, 0.002, and 0.5 µg/L by the Office of Environmental Health Hazard Assessment (OEHHA), respectively.	OEHHA (2023b)
PCBTF*	• PCBTF is classified as a Group 2B carcinogen and is on the Proposition 65 list. An inhalation unit risk factor has been established for it under the California Hot Spots program.	IARC (2020); NTP (2018); OEHHA (2018, 2019)
Benzotrifluoride*	• Benzotrifluoride (trifluoromethylbenzene) in mid and high doses has been reported to cause neurotoxicity (increased excitability), affect the kidney (necrosis, hyaline droplets, basophilic changes, dilatation of the renal proximal tubules, renal hypertrophy and discoloration), and the liver (centrilobular hepatocyte hypertrophy) in rats gavaged with 20, 100, or 500 mg/kg/day of benzotrifluoride for approximately 49 days.	NTP (2005)
Tetrafluoroethylene*	• Tetrafluoroethylene has been listed as a carcinogen under Proposition 65 since 1997. It causes cancer at multiple sites in multiple species.	NTP (1997)
Bifenthrin[5]*	• Bifenthrin causes neurotoxicity and is classified by the US EPA as a possible human carcinogen (Group C) based on increased incidences of urinary bladder tumors observed in studies in mice.	Federal Register (2021)

Chemical	Known or suspected health effects	References
	• Bifenthrin has been reported to decrease sperm motility and kinematic parameters at a concentration of 100 µM in mice spermatozoa and cause detrimental effects on sperm function. • Bifenthrin lowered the serum testosterone levels in mice treated with bifenthrin at doses of 7.5 and 15 mg/kg/day for three weeks and demonstrated endocrine disruption activities when exposed during puberty.	Bae and Kwon (2021) Jin et al. (2015)
Fipronil[5]*	• Fipronil is classified by the US EPA as a possible human carcinogen (Group C) based on increases in thyroid follicular cell tumors in both sexes of the rat, and in 45-day studies in rats exposed via drinking water. It induced lipid peroxidation, oxidative stress, and liver and kidney injury in rats. Studies in animals have shown that fipronil is also neurotoxic and can affect thyroid hormone levels.	CDPR (2023); Mossa et al. (2015); USEPA (2020)
Trifloxystrobin*	• Trifloxystrobin has been shown to be highly immunotoxic to zebrafish embryo development. It induced oxidative stress in embryos through increasing reactive oxygen species and malonaldehyde (MDA), inhibiting superoxide dismutase (SOD) activity and depleting glutathione (GSH) as well as changed catalase activity and mRNA levels of genes related to antioxidant system. Also, exposure to trifloxystrobin affected the immune system by significantly upregulating IFN and CC-chem as well as changed expressions of TNFa, IL-1b, C1C and IL-8. • Exposure to trifloxystrobin resulted in diminished viability in a human keratinocyte cell line (HaCaT) in both a time- and concentration-dependent manner. Trifloxystrobin induced TRAIL-mediated apoptosis and had an inhibitory effect in keratinocytes that could interfere with the barrier function and integrity of the skin.	Li et al. (2018) Jang et al. (2017)
Ethalfluralin*	• Ethalfluralin has been classified as a possible human carcinogen (Group C) based on positive genotoxicity assays (two positive Salmonella assays and a positive assay for chromosomal aberrations) and the findings from a two-year chronic carcinogenicity study in rats (showing an increased incidence of mammary gland fibroadenomas and combined adenomas/fibroadenomas in female rats).	Federal Register (2020)

Chemical	Known or suspected health effects	References
	• Studies indicated that oxidative stress generated by exposure to ethalfluralin induced ROS generation, apoptosis, inflammation, and anti-angiogenic effects in the development of zebrafish embryos.	Hong et al. (2022)
Epoxiconazole*	• Epoxiconazole is listed as a carcinogen under Proposition 65 and classified by the US EPA as a likely human carcinogen. • In vitro and animal studies confirmed that epoxiconazole had endocrine disrupting properties. Also, in rats and rabbits it caused developmental effects such as resorptions, skeletal variations and malformations. • Epoxiconazole showed cytostatic/cytotoxic effects and apoptosis on bovine lymphocytes.	EFSA (2008); Federal Register (2006) Šiviková et al. (2018)

*Chemicals that are not in the current “PFASs” designated chemical group, but which would be included in the potential expansion to “PFASs and other substances with carbon-fluorine bonds.”

Table 7. Selected references on the analytical considerations of PFASs and other substances with C-F bonds.

Analytical considerations	References
• "Targeted analysis" using liquid chromatography-mass spectrometry (LC-MS/MS) allow detection of nonvolatile PFASs in water (drinking water, surface water, groundwater), air/airborne particulates, food, solids (soil, sediment, house dust), and consumer products. PFASs amounts can be quantified by using commercially available chemical standards. • "Suspect screening and nontargeted analysis" using high-resolution mass spectrometry allow discovery and characterization of unidentified PFASs in the environment. Comparing such information with chemical databases that contain thousands of PFAS compounds enables identification of the molecular structure of analytes without analytical standards. Such analysis are typically qualitative.	De Silva et al. (2021)
• Gas-liquid chromatography mass spectrometry can measure PCBTF and its glucuronide conjugates in urine, feces, blood, and tissues. There are studies which detected PCBTF after oral or inhalation exposure to animals.	NTP (2018); Quistad and Mulholland (1983)
• Time-of-flight mass spectrometry is used to measure PCBTF in urban air and suggested to be used as a tracer for solvent-based coatings.	Gkatzelis et al. (2021); Stockwell et al. (2021)
• 1,1-Difluoroethane can be measured in mixed exhaled air samples by automated thermal desorption and analyzed by gas chromatography, and in capillary blood and urine samples by head-space gas chromatography.	Ernstgård et al. (2014)
• Residues of pesticides such as bifenthrin can be detected in plants and crops by gas-liquid chromatography using an electron capture detector. • CFMP (also known as CIF3CA) is an emerging metabolite for bifenthrin and cyhalothrin and can be measured by liquid chromatography mass spectrometry to use as a biomarker of exposure.	Mukherjee et al. (2010); Tarazona et al. (2022); Makris et al. (2022)
• Liquid chromatography-quadrupole time-of-flight mass spectrometry is used to detect and identify fipronil sulfone (a metabolite of fipronil) in serum.	McMahen et al. (2015)
• Liquid chromatography with tandem mass spectrometry is used to detect trifloxystrobin in hair samples of pesticide workers.	Park et al. (2021)
• Quadrupole time-of-flight mass spectrometry is used to identify aqueous film forming foam (AFFFs) derived PFASs, such as fluorotelomer thioether surfactants (FTSHCs) that are released into the environment during response to fire-related emergencies.	Houtz et al. (2018)

Need to Assess Efficacy of Public Health Actions

Biomonitoring of PFASs and other substances with carbon-fluorine bonds would allow Biomonitoring California to determine whether these chemicals are found in California residents and at what levels. Expansion of the current PFASs designated chemical group would be a resource efficient approach. For example, it would facilitate the use of non-targeted laboratory screening methods, allowing the state to determine which substances with at least one carbon-fluorine bond pose the highest exposure concerns in California. Using this approach, Biomonitoring California could identify emerging chemicals of concern and track their levels over time.

References:

Bae J-W, Kwon W-S. 2021. The deleterious toxic effects of bifenthrin on male fertility. Reproductive Toxicology 101:74-80.

Biomonitoring California Designated Chemicals. July 2022. Available: https://biomonitoring.ca.gov/sites/default/files/downloads/DesignatedChemicalsList_July2022.pdf.

Biomonitoring California Priority Chemicals. July 2022. Available: https://biomonitoring.ca.gov/sites/default/files/downloads/PriorityChemicalsList_July2022.pdf.

Biomonitoring California Scientific Guidance Panel Meeting. March 2015. Available: https://biomonitoring.ca.gov/events/biomonitoring-california-scientific-guidance-panel-meeting-march-2015.

Biomonitoring California Scientific Guidance Panel Meeting. November 2021. Available: https://biomonitoring.ca.gov/events/biomonitoring-california-scientific-guidance-panel-meeting-november-2021.

Biomonitoring California Scientific Guidance Panel Meeting. March 2022. Available: https://biomonitoring.ca.gov/events/biomonitoring-california-scientific-guidance-panel-meeting-march-2022-0.

Buck RC, Franklin J, Berger U, Conder JM, Cousins IT, de Voogt P, et al. 2011. Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. Integrated Environmental Assessment and Management 7:513-541.

Carli G, Cosma E, di Domenico A, Macrì A, Young CP. 1983. Pollution by halogenated aromatic compounds at Trissino: A case study of groundwater contamination and rehabilitation. Disasters 7:266-275.

CDPR. 1997. NOTICE OF COMPLETION OF RISK ASSESSMENT FOR THE PESTICIDE PRODUCT TALSTAR® T & O (Bifenthrin). Available: https://www.cdpr.ca.gov/docs/risk/rcd/bifent_g.pdf.

CDPR. 2020. Annual Statewide Pesticide Use Report Chemical Totals. Available: https://www.cdpr.ca.gov/docs/pur/pur20rep/pur_data/pur2020_subtotals_indexed_by_chemical.pdf.

CDPR. 2023. FIPRONIL RISK CHARACTERIZATION DOCUMENT. Available: https://www.cdpr.ca.gov/docs/risk/rcd/fipronil_rcd.pdf.

Custer A, Corse A, Vazirani S. 2020. Difluoroethane Inhalant Abuse, Skeletal Fluorosis, and Withdrawal. Fed Pract 37:288-289.

De Silva AO, Armitage JM, Bruton TA, Dassuncao C, Heiger-Bernays W, Hu XC, et al. 2021. PFAS Exposure Pathways for Humans and Wildlife: A Synthesis of Current Knowledge and Key Gaps in Understanding. Environ Toxicol Chem 40:631-657.

EFSA. 2008. Conclusion regarding the peer review of the pesticide risk assessment of the active substance epoxiconazole. Available: https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/j.efsa.2008.138r.

El-Sheikh EA, Ramadan MM, El-Sobki AE, Shalaby AA, McCoy MR, Hamed IA, et al. 2022. Pesticide Residues in Vegetables and Fruits from Farmer Markets and Associated Dietary Risks. Molecules 27.

Ernstgård L, Sjögren B, Gunnare S, Johanson G. 2014. Blood and exhaled air can be used for biomonitoring of hydrofluorocarbon exposure. Toxicology Letters 225:102-109.

Federal Register. 2006. Epoxiconazole; Pesticide Tolerance. Available: https://www.federalregister.gov/documents/2006/09/13/E6-14994/epoxiconazole-pesticide-tolerance.

Federal Register. 2007a. Lambda-Cyhalothrin; Pesticide Tolerance. Available: https://www.federalregister.gov/documents/2007/08/15/E7-16050/lambda-cyhalothrin-pesticide-tolerance.

Federal Register. 2007b. Fipronil; Pesticide Tolerances. Available: https://www.federalregister.gov/documents/2007/08/22/E7-16621/fipronil-pesticide-tolerances.

Federal Register. 2020. Ethalfluralin; Pesticide Tolerances. Available: https://www.govinfo.gov/content/pkg/FR-2020-07-28/pdf/2020-16266.pdf.

Federal Register. 2021. Bifenthrin; Pesticide Tolerances. Available: https://www.federalregister.gov/documents/2021/12/01/2021-25091/bifenthrin-pesticide-tolerances.

Federal Register. 2023a. Ethalfluralin; Pesticide Tolerances. Available: https://www.federalregister.gov/documents/2023/04/10/2023-07456/ethalfluralin-pesticide-tolerances.

Federal Register. 2023b. Trifloxystrobin; Pesticide Tolerances. Available: https://www.federalregister.gov/documents/2023/06/20/2023-13023/trifloxystrobin-pesticide-tolerances.

Gkatzelis GI, Coggon MM, McDonald BC, Peischl J, Aikin KC, Gilman JB, et al. 2021. Identifying Volatile Chemical Product Tracer Compounds in U.S. Cities. Environ Sci Technol 55:188-199.

Hong T, Park H, An G, Song G, Lim W. 2022. Ethalfluralin induces developmental toxicity in zebrafish via oxidative stress and inflammation. Sci Total Environ 854:158780.

Houtz E, Wang M, Park J-S. 2018. Identification and Fate of Aqueous Film Forming Foam Derived Per- and Polyfluoroalkyl Substances in a Wastewater Treatment Plant. Environmental Science & Technology 52:13212-13221.

IARC. 2020. Vol. 125. Some Industrial Chemical Intermediates and Solvents. (IARC Monographs on the Identification of Carcinogenic Hazards to Humans). Available: https://publications.iarc.fr/596.

Jang Y, Lee AY, Chang S-H, Jeong S-H, Park K-H, Paik M-K, et al. 2017. Trifloxystrobin induces tumor necrosis factor-related apoptosis-inducing ligand (TRAIL)-mediated apoptosis in HaCaT, human keratinocyte cells. Drug and Chemical Toxicology 40:67-73.

Jin Y, Wang J, Pan X, Miao W, Lin X, Wang L, et al. 2015. Enantioselective disruption of the endocrine system by Cis-Bifenthrin in the male mice. Environ Toxicol 30:746-754.

Lava R, Calore F, Mazzola M, Moretto CG, Pretto U, Salmaso P, et al. 2021. Groundwater contamination by fluorinated aromatics: Benzotrifluoride and its derivatives. Chemosphere 265:129029.

Lee EG, Lewis B, Burns DA, Kashon ML, Kim SW, Harper M. 2015. Assessing Exposures to 1-chloro-4-(trifluoromethyl) Benzene (PCBTF) in U.S. Workplaces. J Occup Environ Hyg 12:D123-130.

Li H, Cao F, Zhao F, Yang Y, Teng M, Wang C, et al. 2018. Developmental toxicity, oxidative stress and immunotoxicity induced by three strobilurins (pyraclostrobin, trifloxystrobin and picoxystrobin) in zebrafish embryos. Chemosphere 207:781-790.

Makris KC, Efthymiou N, Konstantinou C, Anastasi E, Schoeters G, Kolossa-Gehring M, et al. 2022. Oxidative stress of glyphosate, AMPA and metabolites of pyrethroids and chlorpyrifos pesticides among primary school children in Cyprus. Environmental Research 212:113316.

McMahen RL, Strynar MJ, Dagnino S, Herr DW, Moser VC, Garantziotis S, et al. 2015. Identification of fipronil metabolites by time-of-flight mass spectrometry for application in a human exposure study. Environ Int 78:16-23.

Mossa A-TH, Swelam ES, Mohafrash SMM. 2015. Sub-chronic exposure to fipronil induced oxidative stress, biochemical and histopathological changes in the liver and kidney of male albino rats. Toxicology Reports 2:775-784.

Mukherjee I, Singh R, Govil JN. 2010. Risk assessment of a synthetic pyrethroid, bifenthrin on pulses. Bull Environ Contam Toxicol 84:294-300.

NTP. 1997. NTP Toxicology and Carcinogenesis Studies of Tetrafluoroethylene (CAS No. 116-14-3) in F344 Rats and B6C3F1 Mice (Inhalation Studies). Natl Toxicol Program Tech Rep Ser 450:1-321.

NTP. 2005. Trifluoromethylbenzene. Available: https://ntp.niehs.nih.gov/ntp/htdocs/chem_background/exsumpdf/trifluoromethylbenzene1_508.pdf.

NTP. 2018. Toxicology and Carcinogenesis Studies of p-Chloro-α,α,α-trifluorotoluene in Sprague Dawley Rats (Hsd: Sprague Dawley SD) and B6C3F1/N Mice (Inhalation Studies). Available: https://ntp.niehs.nih.gov/publications/reports/tr/500s/tr594.

OEHHA. 2015a. Potential Priority Chemicals: Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs). Available: https://www.biomonitoring.ca.gov/sites/default/files/downloads/PotentialPriority_PFASs_111815.pdf.

OEHHA. 2015b. Potential Designated Chemicals: Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs). Available: https://www.biomonitoring.ca.gov/sites/default/files/downloads/PotenDesigPFASs_031315.pdf.

OEHHA. 2018. Notice of Intent to List: p-Chloro-α,α,α-trifluorotoluene (Para-Chlorobenzotrifluoride, PCBTF). Available: https://oehha.ca.gov/proposition-65/crnr/notice-intent-list-p-chloro-aaa-trifluorotoluene-para-chlorobenzotrifluoride.

OEHHA. 2019. Chemical Listed Effective June 28, 2019 as Known to the State Of California To Cause Cancer: P-Chloro-a,a,a-Trifluorotoluene (Para-Chlorobenzotrifluoride, PCBTF). Available: https://oehha.ca.gov/proposition-65/crnr/chemical-listed-effective-june-28-2019-known-state-california-cause-cancer.

OEHHA. 2020. p-Chloro-α,α,α-trifluorotoluene (p-Chlorobenzotrifluoride, PCBTF) Cancer Inhalation Unit Risk Factor. Available: https://oehha.ca.gov/media/downloads/crnr/pcbtfiur012820.pdf.

OEHHA. 2023a. Proposition 65 Listed Chemicals. Available: https://www.p65warnings.ca.gov/chemicals.

OEHHA. 2023b. Notification Levels for Chemicals in Drinking Water. Available: https://oehha.ca.gov/water/notification-levels-chemicals-drinking-water.

Organization for Economic Cooperation and Development (OECD). 2021. Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance. Paris. Available: https://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/terminology-per-and-polyfluoroalkyl-substances.pdf.

Park E, Lee J, Lee J, Lee J, Lee HS, Shin Y, et al. 2021. Method for the simultaneous analysis of 300 pesticide residues in hair by LC-MS/MS and GC-MS/MS, and its application to biomonitoring of agricultural workers. Chemosphere 277:130215.

Quirós-Alcalá L, Bradman A, Nishioka M, Harnly ME, Hubbard A, McKone TE, et al. 2011. Pesticides in house dust from urban and farmworker households in California: an observational measurement study. Environmental Health 10:19.

Quistad GB, Mulholland KM. 1983. Metabolism of p-chlorobenzotrifluoride by rats. J Agric Food Chem 31:585-589.

Scaranto J, Moro D, Tasinato N, Stoppa P, Giorgianni S. 2015. Insights into the interaction between CH2F2 and titanium dioxide: DRIFT spectroscopy and DFT analysis of the adsorption energetics. Spectrochim Acta A Mol Biomol Spectrosc 136 Pt C:1614-1620.

Senate Bill No. 1044. Available: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB1044.

Senate Bill No. 1379. Available: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060SB1379.

Šiviková K, Holečková B, Schwarzbacherová V, Galdíková M, Dianovský J. 2018. Potential chromosome damage, cell-cycle kinetics/and apoptosis induced by epoxiconazole in bovine peripheral lymphocytes in vitro. Chemosphere 193:82-88.

Spencer J, O'Malley M. 2006. Pyrethroid illnesses in California, 1996-2002. Rev Environ Contam Toxicol 186:57-72.

Stockwell CE, Coggon MM, Gkatzelis GI, Ortega J, McDonald BC, Peischl J, et al. 2021. Volatile organic compound emissions from solvent- and water-borne coatings – compositional differences and tracer compound identifications. Atmos Chem Phys 21:6005-6022.

Tarazona JV, Cattaneo I, Niemann L, Pedraza-Diaz S, González-Caballero MC, de Alba-Gonzalez M, et al. 2022. A Tiered Approach for Assessing Individual and Combined Risk of Pyrethroids Using Human Biomonitoring Data. Toxics 10.

USEPA. 2020. Fipronil: Draft Risk Assessment for Registration Review. Available: https://downloads.regulations.gov/EPA-HQ-OPP-2011-0448-0076/content.pdf.

Van Sant F, Hassan SM, Reavill D, McManamon R, Howerth EW, Seguel M, et al. 2019. Evidence of bromethalin toxicosis in feral San Francisco "Telegraph Hill" conures. PLoS One 14:e0213248.

Weston DP, Holmes RW, You J, Lydy MJ. 2005. Aquatic Toxicity Due to Residential Use of Pyrethroid Insecticides. Environmental Science & Technology 39:9778-9784.

Weston DP, Ramil HL, Lydy MJ. 2013. Pyrethroid insecticides in municipal wastewater. Environ Toxicol Chem 32:2460-2468.

Xia X, Zheng Y, Tang X, Zhao N, Wang B, Lin H, et al. 2022. Nontarget Identification of Novel Per- and Polyfluoroalkyl Substances in Cord Blood Samples. Environ Sci Technol 56:17061-17069.