Metro

Toxics reduction and equity

Informing actions to reduce community risks from chemicals in products

July 2019

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Metro

If you picnic at Blue Lake or take your kids to the Oregon Zoo, enjoy symphonies at the Schnitz or auto shows at the convention center, put out your trash or drive your car – we've already crossed paths.

So, hello. We're Metro – nice to meet you.

In a metropolitan area as big as Portland, we can do a lot of things better together. Join us to help the region prepare for a happy, healthy future.

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Juan Carlos Gonzalez, District 4
Sam Chase, District 5
Bob Stacey, District 6

Auditor
Brian Evans

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Author
Monica Cuneo, MPH, Context for Action

Metro Project Manager, Lead Editor
Carl Grimm, Senior Solid Waste Planner, Resource Conservation and Recycling

Context for Action Research Team
Carri Munn, MPA
Elizabeth Doerr, MIEP
Molly Notarianni

Metro Project Team
Matt Korot, executive sponsor, Resource Conservation and Recycling Director
Pam Peck, project sponsor, Resource Conservation and Recycling Manager
Scott Klag, Senior Solid Waste Planner, Resource Conservation and Recycling
Lisa Heigh, Senior Solid Waste Planner, Resource Conservation and Recycling
Sabrina Gogol, Senior Management Analyst, Property & Environmental Services
Jim Quinn, Principal Regional Planner, Property & Environmental Services
Farrah Fatemi, Ph.D., Educational Outreach Specialist, Resource Conservation and Recycling

Stakeholder contributions
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Peer reviewers
Lisa Cox, Senior Toxics Reduction Analyst, Oregon Department of Environmental Quality
Michelle Gin, MPH, Toxic Free Kids Communications Planner, Minnesota Department of Health
Kevin Masterson, MURP, Agency Toxics Coordinator, Oregon Department of Environmental Quality
Karl Palmer, Acting Deputy Director, Safer Products and Workplaces Program, California Department of Toxic Substances Control
Raahi Reddy, MUP, Director of Diversity, Equity and Inclusion, Metro
Nancy Rice, MPH, Research Scientist, Minnesota Department of Health
Justin Waltz, MPH, Program Analyst, Oregon Health Authority

Stakeholder interviewees
Jennifer H. Allen, Ph.D., Associate Professor of Public Administration, Portland State University
Jae P. Douglas, Ph.D., MSW, Environmental Health Services Director, Multnomah County Health Department
Jen Jackson, Toxics Reduction & Healthy Ecosystems Program Manager, San Francisco Department of Environment

Andrea Hamberg, Environmental Health Program Supervisor, Multnomah County Health Department
Scott Klag, Senior Solid Waste Planner, Metro
Kevin Masterson, Toxics Coordinator, Oregon Department of Environmental Quality
Tina Schaefer, Children's Safe Products Act Program Lead, Washington Department of Ecology
Kara Steward, PFAS Chemical Action Plan Coordinator, Washington Department of Ecology
Heather Trim, Executive Director, Zero Waste Washington
Kari Trumbull, Product Testing Chemist, Washington Department of Ecology
Ken Zarker, Pollution Prevention Section Manager, Washington Department of Ecology

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Dianne Barton, Water Quality Coordinator, Columbia River Inter-Tribal Fish Commission, Chair, National Tribal Toxics Council
Topher Buck, IC2 Project Manager, NEWMOA
Kimberlee Chambers, Director of Integrated Business Planning and Sustainability, RainSweet, Inc.
Lauren Cole, Environmental Programs Managing Supervisor, King County
Gabriela Goldfarb, Environmental Public Health Section Manager, Oregon Health Authority
Tim Greiner, Managing Director, Pure Strategies
Brendon Haggerty, Program Coordinator, Multnomah County Health Department
Phil Keisling, Director, Center for Public Service, Portland State University
Brian Martin, Senior Director, Seagate
Hugh O'Neill, Toxics Reduction Team Leader, Washington Department of Ecology
Wayne Rifer, Retired Director of Research and Standards, Green Electronics Council
Mark S. Rossi, Ph.D., Executive Director, Clean Production Action
Joel Tickner, Professor, Lowell Center for Sustainable Production, Zuckerberg College of Health Sciences, University of Massachusetts

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Contact

For more information about this study or about Metro's toxics reduction work, please contact:

Carl Grimm, carl.grimm@oregonmetro.gov, 503-797-1676
Pam Peck, pam.peck@oregonmetro.gov, 503-797-1866

We hope this study is a useful resource. We encourage your comments and suggestions for advancing this work. Please contact us with questions or feedback, and to let us know how you use this information.

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Toxics reduction and equity

Informing actions to reduce community risks from chemicals in products

EXECUTIVE SUMMARY

This study explores disproportionate community health impacts that may be linked to chemicals found in consumer products, garbage and recycling. It also identifies opportunities for Metro - the regional government in the greater Portland, Oregon area - and others to eliminate or reduce health and environmental impacts from the full life cycle of products through cross-sector collaborations, policy, programs and research. Paths toward broad systems change are identified to address root causes of interconnected "wicked problems" including the impacts of toxic chemicals on people and the environment, racism, and other structural inequities in our society and economy.

Cumulative Risk and Targeted Universalism are proposed as the base of an equity framework. Stakeholder interviews and a literature review revealed a fragmented, under-resourced regulatory context. Reviews of ten consumer product categories from *Apparel and outdoor wear* to *Worker exposures in the service sector* found disproportionate health risks to communities of color, children, women and workers. Interviewees identified a system of advocates, researchers, governments and industry that are involved in and necessary for reducing toxics in products, and pointed out key gaps in that system including data, funding, strategic alignment and an equity focus.

Opportunities for action include advocating for priority policies and programs at the state, local and federal levels, conducting and supporting priority research and education, and convening cross-sector stakeholders for greater collective impact. This Study was developed in parallel with Metro's 2030 Regional Waste Plan and includes actions from the plan. Findings from this Study are intended to help inform conversations in the greater Portland region and beyond between a broad array of stakeholders, including affected communities, advocates, researchers, governments and industry to catalyze broad systems change for a toxic-free environment.

Metro's long involvement in toxics reduction work

Metro has a strong interest in toxics reduction and related chemicals policy issues originating in part from its responsibility to steward the region's waste stream which includes ensuring proper management of toxic materials such as household hazardous wastes. In addition, as a regional government that recognizes problems do not stop at city and county boundaries, the Metro Council's desired outcomes include ensuring clean air and water for residents of the region.

Over the past several decades, Metro has developed a nationally recognized program to collect and responsibly manage hazardous wastes from households and small businesses. Metro has also implemented public education programs aimed at reducing the use of products containing hazardous substances and promoting alternatives. During this time, Metro has worked with interested parties on policies, legislation and regulations to reduce toxics. In this work, Metro has learned about the need for, and the elements of, better approaches to manage chemicals in products in order to protect human health and the environment.

Toxic chemicals in consumer products a "wicked problem"

Historically, developing policies to manage chemicals has been extremely challenging. As noted by researcher J. Allen, the situation is "a classic 'wicked problem'" where the "biological, physical and social complexity" of the issues resist simple solutions. Chemicals policy, like climate change, extends "across media such as air, land, and water; across political jurisdictions and landscape boundaries; and across traditional policy arenas." "Existing toxics policies often exacerbate the 'wicked' nature of this issue by ignoring its inherent complexity and the need to bridge across agencies, jurisdictions, and constituencies to effectively manage these substances." Allen points to the need for policies that are more collaborative and acknowledge the "incompleteness of current knowledge" in addressing this wicked problem.[1]

Toxics reduction and equity (this Study) builds on Allen's recommendations by using a systems approach,[2] which is a shift from the traditional mindset of considering problems with individual toxics in separate contexts to one that recognizes the complex network of interdependencies among problems and solutions. This approach critically examines the underlying patterns, structures, and thinking that create the results - or the issue - seen on the surface. When we shift our perspective to embrace a holistic, whole-systems view, the need for coordinating, problem-solving and acting together to uncover and address root causes becomes clear. This Study aims to shed light on how this complex problem can be addressed regionally using a systems approach through prioritized local actions, collaboration, and strategic alignment with broader, collective actions at the national and global levels.

Success factors for systems change

- A system-wide perspective of interdependence among players, processes and materials
- Realistic conversations about what it will take and the consequences of inaction
- Innovation mindset and willingness to take risks
- Bridge-building to open boundaries and silos
- Broad participation, shared responsibility, and clear commitment

Toxics reduction and equity and Metro's 2030 Regional Waste Plan

This Study has been developed in parallel with the 2030 Regional Waste Plan[3] to inform those aspects of the plan that aim to reduce chemicals of concern in products and in the waste stream of the greater Portland area. The 2030 Regional Waste Plan, and its extensive community engagement process has also informed the development of this Study. Specific actions and principles from the plan are included in the *Equity framework* and *Conclusion and opportunities for action* sections of this Study. The 2030 Regional Waste Plan is a blueprint for greater Portland's garbage and recycling

[1] Allen, Jennifer H. "The wicked problem of chemicals policy: opportunities for innovation." *Journal of Environmental Studies and Sciences*, Springer, 2013, https://link.springer.com/article/10.1007/s13412-013-0117-0.
[2] "Systems Thinking Resources." Academy for Systems Change, *Donella Meadows Project*, 1996-2019, http://donellameadows.org/systems-thinking-resources/.
[3] "2030 Regional Waste Plan: Equity, Health and the Environment." Metro, March 2019, https://www.oregonmetro.gov/regional-waste-plan.

system that will guide specific actions by Metro and the cities and counties in Metro's jurisdiction over the next 12 years.

The importance of equity

Metro recognizes that hazardous wastes and products containing hazardous chemicals can have disproportionate impacts on communities of color and other historically marginalized groups, as well as on vulnerable populations including children and the elderly. Metro is committed to ensuring that all people in the region have the opportunity to thrive in all aspects of social well-being, regardless of their background. In order to achieve this goal, Metro has identified racial equity as a strategic priority, as detailed in the Strategic Plan to Advance Racial Equity, Diversity and Inclusion[4] (Equity Strategy). The plan focuses on five goals: A - Metro convenes and supports regional partners to advance racial equity. B - Metro meaningfully engages communities of color. C - Metro hires, trains and promotes a racially diverse workforce. D - Metro creates safe and welcoming services, programs and destinations. E - Metro's resource allocation advances racial equity. These goals are further refined through specific action plans developed and implemented by Metro departments.

Operationalizing toxics reduction equity begins with two frameworks

Two frameworks are used to begin the incorporation of equity into toxics reduction work. The first is Cumulative Risk, which describes how risks for developing poor health outcomes are amplified when exposure to chemicals is combined with exposure to social stressors such as economic hardship, racism and other social determinants of health.[5] Chemical and non-chemical stressors are considered together, as pieces of a puzzle interacting with one another, to gain a clearer image of a community's overall health risk.

The second framework is Targeted Universalism, which is an approach that underpins Metro's Equity Strategy and can be used to broadly inform policy and program responses to priority toxics issues.[6] This approach suggests focusing efforts on removing chemical and other stressors on highly impacted communities, or those experiencing large disparities, to bring the region as a whole closer to the universal goal of all people having the opportunity to thrive.

Using the Cumulative Risk and Targeted Universalism frameworks is just the beginning. They help to identify potential issues of concern and very broadly guide how to address them. The work of actually selecting and addressing issues of concern needs to be pursued in collaboration with community partners who reflect the groups impacted by the issues of concern. In Metro's case, this last step is guided by the Strategic Plan to Advance Racial Equity, Diversity and Inclusion, which itself was created in collaboration with diverse community partners. The work of engaging community in the development and implementation of toxics reduction priorities is also guided by Metro's Property and Environmental Services Department Diversity, Equity and Inclusion (DEI)

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[4] "Strategic Plan to Advance Racial Equity Diversity and Inclusion." Metro, June 2016, https://www.oregonmetro.gov/sites/default/files/2017/10/05/Strategic-plan-advance-racial-equity-diversity-inclusion-16087-20160613.pdf.

[5] "Environmental health disparities: A framework integrating psychosocial and environmental concepts." *Environmental Health Perspectives*, Dec. 2004, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1253653/.

[6] Ibid. "Metro Strategic Plan to Advance Racial Equity Diversity and Inclusion." Metro.

Work Plan, 2018-2020.[7] Lastly and most directly, Metro's work to operationalize equity for reducing community health impacts from toxics in consumer products is guided by the 2030 Regional Waste Plan.

The fragmented regulatory context and rise of chemicals policy reform

The federal legislative framework for managing chemicals – largely developed in the 1970s – is fragmented and ill-coordinated, leaving large gaps in public safety and little incentive for manufacturers to develop safer alternatives to toxic chemicals. Many state governments have stepped up in an attempt to reform chemicals policy and fill these gaps with local laws and programs. State efforts helped to stimulate and inform some long-overdue improvements to a key federal chemicals law, the Toxic Substances Control Act (TSCA) in 2016.

The need and drive for chemicals policy reform is still present and advancing, with states, advocacy organizations and industry groups pushing to close the gaps, reframe how we think about chemicals policy, incorporate equity, engage multi-stakeholder groups, and advance green chemistry. Progress has also been made outside the US, such as in the European Union's REACH (Registration, Evaluation, Authorization and Restriction) regulation enacted in 2006. In contrast to U.S. chemicals policy, REACH places responsibility on industry to manage the risks from chemicals and provide safety information, stimulating innovation. REACH is often summed up as "no data, no market,"[8] and is seen by many as a model.

> *Consumers are concerned, non-governmental organizations are conducting successful advocacy campaigns, states are enacting chemicals policy laws, manufacturers and retailers are creating safer chemical selection programs, foreign and international governments are creating new chemical policies and science is generating safer chemicals. However, these efforts are fragmented and need to be woven into a broad safer chemicals strategy that strengthens the movement to solve the Chemicals Problem and create a vibrant, productive, safer economy.*[9]

Consumer product literature reviews

Included in this Study is a set of ten literature reviews for potential disproportionate community health impacts from chemicals of concern used in consumer products ranging from *Apparel and outdoor wear* to *Worker exposures in the service sector*. The product categories selected are all known to use chemicals of concern in their manufacture, and may either be marketed to or for vulnerable populations (such as children), employ historically marginalized groups (such as women of color) in manufacture or service delivery, or are an Oregon Department of Environmental Quality Materials Management priority high-impact material category.[10]

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[7] "Metro's Property and Environmental Services Department Diversity, Equity and Inclusion (DEI) Work Plan, 2018-2020." Metro, June 2018, https://www.oregonmetro.gov/sites/default/files/2018/06/29/PES-DEI-Workplan-2018-2022-06212018.pdf.
[8] "REACH." *The European Commission*, http://ec.europa.eu/environment/chemicals/reach/reach_en.htm.
[9] Geiser, Ken. "Chemicals Without Harm, Policies for a Sustainable World." Lowell Center for Sustainable Production, 2015, https://pprc.org/wp-content/uploads/2015/11/Lunch-Presentation_Ken-Geiser_Roundtable-2015.pdf.
[10] "Administrative Order No. DEQ 3-2017." *Oregon Bulletin*, filed and effective Jan. 19, 2017, https://www.oregon.gov/deq/Regulations/rulemaking/Pages/Rrecycling2016.aspx.

The selection of consumer product categories and the body of research cited in these reviews is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified in each. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

In addition to the human health risk research, each review includes a high-level, non-exhaustive description of the regulatory context for the specific consumer products, with an emphasis on federal law as well as policies and programs in Oregon, Washington and California.

Key findings from consumer product literature reviews

A large body of research establishes both the presence of chemicals of concern within the products reviewed, as well as a wide array of associated and serious health risks. Considering the effects of Cumulative Risk described in the *Equity framework* section, communities experiencing economic hardship, racism and other social determinants of health have increased risk for poor health outcomes than those who do not. A smaller, but significant subset of studies cited also document disproportionate exposures or disproportionate risks to communities of color and other historically marginalized groups. Specific racial and ethnic groups identified in literature cited included African American, Latinx and Asian American. Children and youth, women of reproductive age and industry-specific workers were identified in nearly every product category as populations at higher risks due to increased exposure pathways or developmental vulnerability. Nearly every product category included chemicals linked to reproductive and cardiovascular impacts, endocrine disruption and neurological disorders. Most also identified links to cancers and developmental impacts. Significant regulatory gaps as well as promising advances and industry innovations are also identified in the consumer product literature reviews.

Stakeholder perspectives

Advocates, regulators, agency representatives and researchers offered their perspectives on what it will take to reduce, mitigate or eliminate chemicals of concern from consumer products. While a wide variety of perspectives emerged, nearly all interviewees saw the value of convening advocates, regulators, researchers and industry leaders at the same table to intentionally allow for jurisdictional and role-specific influence, perspective and expertise to inform systems-scale solutions. By convening key sectors and perspectives, solutions can be generated that outpace the speed of the federal government in public health protections. For example, as several interviewees pointed out, industry leaders are often more willing to bend away from toxics manufacturing and use when there are viable alternatives on the table. Gaps in the system of stakeholders and strategies aimed at reducing toxics in products identified by interviewees include data, funding, strategic alignment and equity.

Opportunities for action

The following ideas emerged out of the rich history of chemicals policy reform efforts and related research revealed in the literature as well as from the stakeholder interviews with advocates, regulators, researchers and agency representatives. Some of these ideas were generated during the development of - and are incorporated into - the 2030 Regional Waste Plan. A more detailed description of these opportunities are included in this Study's *Conclusion and opportunities for action* section.

A. Advocate for and advance priority policies and programs using the Targeted Universalism framework. Examples include state regulation, funding legislation and rulemaking as well as local government policies and programs with high likelihood of reducing health and environmental impacts on communities of color and health-vulnerable populations. Examples include Oregon's Toxic Free Kids Act, Metro's Product Stewardship for Household Hazardous Waste in the 2019 Oregon legislative session and reclassification of priority urban pesticides.

B. Conduct and support priority research and education using a Cumulative Risk framework. Examples include product testing for chemicals of concern, community health impact research, biomonitoring, and tracking emerging chemicals research, policies, programs and initiatives. Priority education advances policy and skills development for community health impact reduction.

C. Convene cross-sector stakeholders, and participate in collaborations that build on and contribute to community, local government, state, industry and NGO toxics reduction successes locally, nationally and globally.

Conclusion

This Study will inform Metro's conversations with community and other partners to identify common priorities to pursue in a collective effort to push the work of achieving a safer more equitable economy forward. Metro is committed to advancing toxics reduction and equity directly through its own authority and resources as well as through collaborations with community, local, state and federal government, researchers and industry. Metro encourages others to use the findings in this Study to advance equity, toxics reduction and related systems-change work.

> *"Whether the growth in chemicals becomes a net positive or a net negative for humanity depends on how we manage the chemicals challenge. What is clear is that we must do much more, together."*
>
> *Joyce Msuya, Acting Executive Director of UN Environment*[11]

[11] "UN report: Urgent action needed to tackle chemical pollution as global production is set to double by 2030." Press release, *United Nations Environment*, 11 Mar. 2019, https://www.unenvironment.org/news-and-stories/press-release/un-report-urgent-action-needed-tackle-chemical-pollution-global.

INTRODUCTION

History of chemicals policy in the United States

The policy and legislative framework for managing chemicals in the United States is extremely complex, consisting of several extensive federal acts and as many associated implementing agencies. Ken Geiser, Professor Emeritus at University of Massachusetts Lowell, in his recent book *Chemicals without Harm* provides an excellent overview of how that framework mostly emerged in a burst of activity in the 1970s.

> "The Environmental Protection Agency (EPA) was created in 1970, following the passage of the National Environmental Policy Act (NEPA). That same year, the Clean Air Act and the Occupational Safety and Health Act (OSHAct) were enacted, and two years later the Clean Water Act was passed. In 1974, the Safe Drinking Water Act was passed, and two years after that Congress enacted the Resource Conservation and Recovery Act (RCRA) to manage municipal and industrial wastes. These ambitious environmental protection laws provided the new EPA with authority to set ambient and emission standards and require permits for the release of hazardous chemicals to the environmental media.
>
> The OSHAct focused on protecting the work environment from the dangers of toxic chemicals and authorized a new Occupational Health and Safety Administration (OSHA) to set and enforce workplace chemical exposure standards. Over this same period, the federal government enacted and amended laws focused directly on the manufacture and use of toxic and hazardous chemicals. Between 1972 and 1976, Congress amended and strengthened earlier laws intended to regulate chemical ingredients used in foods, drugs, and pesticides and passed the Toxic Substances Control Act (TSCA) and the Consumer Product Safety Act. Today these chemical control laws create the structural framework for the nation's chemical control policies."[12]

Geiser also describes the myriad of events and public controversies (e.g., lead exposures, Bhopal India accident) that helped spur and shape that legislation. However, he concludes that the United States' chemicals policies are not what they need to be.

> "The chemical control policy framework of the last century has left a disappointing legacy. The policies have created a fragmented and ill-coordinated array of regulatory instruments and government programs. Some laws have worked better than others. [The Federal Insecticide, Fungicide and Rodenticide Act] FIFRA and [the Food Drug and Cosmetics Act] FDCA have established comprehensive oversight over pesticides and pharmaceuticals. However, the EPA [under TSCA] has largely ignored the vast majority of existing industrial chemicals, and in practice, the [Consumer Product Safety Commission] CPSC only attends to hazardous chemicals in those products that have raised public concern."[13]

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[12] Geiser, Ken. *Chemicals without Harm, Policies for a Sustainable World*. The MIT Press, 2015.
[13] Ibid. Geiser, Ken. *Chemicals without Harm, Policies for a Sustainable World*. The MIT Press, 2015.

Geiser describes the policy framework that developed as one based on control.

> "Although each of the laws emerged from a unique history, they all started with the premise that some substances present unreasonable risks and need to be controlled, primarily through the use of government regulations. The concept of control is a central theme. The laws vary on how the risks are to be determined and what criteria are to be used to determine a reasonable (acceptable) risk from an unreasonable (unacceptable) risk. However, where unreasonable risks are identified, the laws authorize government controls ranging from restrictions on marketing and use, conditions for special handling and applicator training to requirements for product labeling and outright prohibition on chemical or product marketing and importation."[14]

He identifies a number of failings of this "control" approach that have led to the current unsatisfactory outcomes.

Failings of the "chemical control" approach

- The chemical-by-chemical approach focusing only on the most hazardous chemicals is too limited in scope and too long, slow, and costly.
- The absence of sufficient chemical information significantly compromises government policy and limits regulatory effectiveness.
- Both risk assessment and cost-benefit analysis have slowed and increased the costs of regulatory initiatives.
- Although considerable government effort has been put forth to study and characterize some chemicals, far less effort has been made to develop safer alternatives.[15]

The *Regulatory context* section and *Appendix 1: Federal regulatory history and structure* of this Study provide a detailed overview of the various legislation and agencies comprising the current federal chemicals policy framework.

The emergence of chemicals policy reform and state actions

During the late 1990s and early 2000s, a growing dissatisfaction with TSCA among both government and environmental advocates on how chemicals were regulated helped generate a movement to establish a new policy and regulatory basis for U.S. chemicals policies. Three critical weaknesses or "gaps" in TSCA were identified by Wilson and Schwarzman.

- **Data gap -** Producers are not required to investigate and disclose sufficient information on the hazard traits of chemicals to government, the public or businesses that use chemicals.
- **Safety gap -** Government lacks the legal tools it needs to efficiently identify, prioritize and take action to mitigate the potential health and environmental effects of hazardous chemicals.

[14] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.

[15] Ibid. "Chemicals without Harm, Policies for a Sustainable World." Presentation by Ken Geiser.

- **Technology gap -** Industry and government have invested only marginally in green chemistry research, development and education.[16]

Wilson and Schwarzman also set out the objectives TSCA reform needed to meet:

- **Close the data gap -** Provide for the effective operation of the chemicals market by requiring that chemical producers generate, disclose, distribute and effectively communicate sufficient information to stakeholders on the hazard properties of chemicals.
- **Close the safety gap -** Provide government with the legal tools necessary to identify, prioritize and take action to reduce chemical hazards and exposures.
- **Close the technology gap -** Build capacity in cleaner chemicals and processes by incorporating scientific, technical, legal and policy-related elements of green chemistry into the nation's education and research infrastructure.[17]

When over a period of more than two decades the federal government failed to act to protect the public, individual states began taking action on their own in a number of areas:

> "…states began to push new chemical management policies with legislation on pollution prevention, chemical restrictions, toxic use reduction, product labeling, and bans on single chemicals. Although these policy initiatives were important, they varied widely among the states, creating a patchwork of diverse laws and regulations that made the marketing of chemicals and products difficult across the nation."[18]

In 2013 a report prepared for the National Pollution Prevention Roundtable and the Washington Department of Ecology was able to identify six states where significant chemical policy action had taken place. The report also listed many more states who had acted on individual chemical issues. The report summarized the key themes found in state efforts.

Key themes found in state chemicals policy efforts:

- States are transitioning from single-chemical solutions to comprehensive and holistic approaches.
- States are using prioritization as a strategy to protect vulnerable populations and to meet regional needs.
- States are embracing environmentally-preferable purchasing policies as a means to reduce toxic chemical use and hazardous waste generation.
- Even as many states move to comprehensive, risk-based systems for chemical management, restrictions on specific hazardous chemicals remains an important policy tool.

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[16] Wilson, Michael P. and Schwarzman, Megan R. "Toward a New U.S. Chemicals Policy: Rebuilding the Foundation to Advance New Science, Green Chemistry, and Environmental Health." *Environmental Health Perspectives*, 9 Feb. 2009, https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.0800404.
[17] Ibid. "Toward a New U.S. Chemicals Policy:" Wilson and Schwarzman, 2009.
[18] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.

- States are embracing product life cycle management solutions to prevent toxics release, rather than relying exclusively on end-of-pipe cleanup.
- States recognize the need for more information on toxic chemicals, including which chemicals are present in which products, which chemicals are present in people, and exposure levels.[19]

Leadership in sustainable chemicals policy: opportunities for Oregon

In Oregon, a report by Allen and Dinno in 2011 entitled *Leadership in Sustainable Chemicals Policy: Opportunities for Oregon* was commissioned by Metro, the Oregon Department of Environmental Quality and others. It brought the concept of "closing the gaps" in chemicals policy together with the authors' perspective on the importance of stakeholder engagement to addressing the complex (even "wicked"[20]) dimensions of chemicals policy. The report made four recommendations for improving chemicals policy in Oregon:[21]

1. Strengthen coordination and development of shared goals among agencies.
2. Prioritize the most hazardous chemicals, the most vulnerable people, and the most sensitive and most toxic environments.
3. Provide incentives for identifying and developing safer alternatives to the most highly toxic chemicals.
4. Promote education and workforce development to lay the foundation for long-term innovation. Expand interdisciplinary approaches to education, internships and workforce development.

Oregon Chemicals Policy Roundtable

Following the approach proposed by Allen and Dinno, the Oregon Chemicals Roundtable (a group of public and nonprofit state and local stakeholders co-founded by Metro) developed the *Strategic Action Plan: Toxic Reduction + Green Chemistry.*[22] The action plan laid out a set of strategies centered on protecting vulnerable communities and making the case for chemicals policy reform across the state.

Alternatives assessment and informed substitution

Chemical alternatives assessment is an emerging field of practice aimed at identifying safer chemicals and approaches to replace chemicals of concern. First described by O'Brien in a 2000 book titled *Making Better Environmental Decisions*,[23] it has been advanced by the U.S. National Research Council, the Lowell Center for Sustainable Production and the Interstate Chemicals

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[19] "State Chemicals Policy – Trends and Profiles." Ross Strategic, National Pollution Prevention Roundtable and Washington Department of Ecology, 2013, http://www.p2.org/2013/04/state-chemicals-policy-trends-and-profiles/.

[20] Ibid. "The wicked problem of chemicals policy: opportunities for innovation." 2013.

[21] Allen, Jennifer H. and Dinno, Alexis. "Leadership in Sustainable Chemicals Policy: Opportunities for Oregon." *Institute for Sustainable Solutions Publications and Presentations*, 2011. 43. https://pdxscholar.library.pdx.edu/iss_pub/43.

[22] Brukman, Eden; Hackenmiller Paradis, Renee and Simon, Deanna. "Strategic Action Plan: Toxics Reduction + Green Chemistry." Commissioned by Metro for the Oregon Chemicals Policy Roundtable, 2014.

[23] O'Brien, Mary. *Making Better Environmental Decisions, An Alternative to Risk Assessment*. The MIT Press, Cambridge, Massachusetts, 2000.

Clearinghouse, among numerous scientists in industry, NGOs and governments across the globe. Alternatives assessment has been incorporated into several state policies including California's Safer Consumer Products program and Oregon's Toxics Free Kids Act as a means to ensure that chemicals of concern are not replaced with more or equally problematic chemistries. The primary goals of alternatives assessment are to 1) support informed substitution of chemicals of concern with chemicals, materials or processes of lower concern and 2) to support the design of products within which the chemicals and materials used are "safer by design." [24]

Elements of a reformed chemicals policy

The several streams of chemicals policy reform started to flow together in recent years. At the state level, a number of states passed significant chemicals policy legislation. Both Washington and Oregon passed legislation requiring the disclosure - and in Oregon potentially the removal – of chemicals of concern in children's products. Those and other actions at the state and local level helped add to the momentum surrounding the movement toward chemicals policy reform at the national level. This eventually led to a successful effort in 2016 to pass the first major revision to TSCA since it was adopted in 1976.

The specific changes to TSCA in 2016 included the following:

- **Established a risk-based safety standard free of a cost benefit analysis requirement**
  Previously TSCA regulation required a chemical to not just represent an "unreasonable risk" but also, any regulation would have to be subject to a cost benefit analysis. Further, any regulation needed to be demonstrated to be the "least burdensome" approach. The revised law separates the determination of the "unreasonable risk" of a substance from how that substance could be regulated. Only health and environmental risks – not costs – will be weighed in determining unreasonable risk. In addition, the requirement that regulations be "least burdensome" was eliminated.
- **Includes explicit protections for vulnerable subpopulations**
  The law defines those populations as those "who, due to either greater susceptibility or greater exposure, may be at greater risk than the general population of adverse health effects from exposure to a chemical substance or mixture, such as infants, children, pregnant women, workers, or the elderly (Section 3)". The EPA will be required "to consider, identify, assess and eliminate any unreasonable risk a chemical presents or may present to "potentially exposed or susceptible subpopulations." No such factor was present in the original law."
- **Includes safety review of both existing and new chemicals**
  Under the previous version, TSCA grandfathered in tens of thousands of chemical and required no review of their safety. The new law will prioritize existing chemicals needing review and changes "the new chemical review process from a passive one to an active one, and provides the Agency with the mandate and authority to make affirmative findings and, when necessary, restrict market access."

[24] "About." Association for the Advancement of Alternatives Assessment, https://www.saferalternatives.org/about.

- Expanded EPA's chemical testing authority and addresses how information is shared by chemical companies. [25]

Chemical policy reform advocates have varied views regarding the TSCA reforms. The provisions in the bill which preempt the ability of a state to act once the EPA begins the review of a chemical was a considerable matter of discussion during the debate over the bill and may be a contentious issue in the future. Keeping watch over how the new TSCA is actually implemented will also be critical. There have already been controversies regarding initial rule makings conducted by EPA.[26]

Chemicals policy reform following 2016

The importance of TSCA reform should not be discounted. In particular, the adoption of a comprehensive approach (*all* chemicals must be reviewed), a mandate to consider the impact of chemicals on vulnerable populations and new authority on testing and sharing of information are extremely valuable. The immediate impact of the reforms, however, may be modest as the resources available to EPA – while greater and more secure than before – are limited.[27] In addition, the full range of issues on chemicals policy reformists' agenda were not addressed by TSCA reform.

The elements of chemicals policy reform going forward will include the following:
Overall, chemicals policy reform moving forward needs to continue to "shift the focus of policies from controlling hazardous chemical risks to transforming the chemical industry to safer chemicals." [28]

- **Continue to close the "data" and "safety" gaps**
  While a reformed TSCA assists here, many other actors (state and local government, university researchers, NGOs and corporations) can identify and gather data on the impacts of chemicals of concern. Examples include: toxics monitoring of both humans and the environment; implementing legislation that requires disclosure (e.g., Oregon's Toxics Free Kids Act); supporting expansion of the Interstate Chemicals Clearinghouse and related efforts.
- **Reframe the idea of chemicals policy** [29]
  - Move from an emphasis on reducing risks through "exposure control" to reducing inherent hazards.
  - Characterize and classify all chemicals, not just the most hazardous.
  - Establish processes to accelerate a transition from the use of high hazard to lower hazard substances.
  - Build a chemicals industry that can supply lower (or no) hazard substances.
  - Change from thinking of single chemicals to classes of chemicals.

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[25] Denison, Richard A. "A primer on the new Toxic Substances Control Act (TSCA) and what led to it." Environmental Defense Fund, April 2017, https://www.edf.org/sites/default/files/denison-primer-on-lautenberg-act.pdf.
[26] Ibid. "A primer on the new Toxic Substances Control Act…" Denison.
[27] Ibid. "A primer on the new Toxic Substances Control Act…" Denison.
[28] Ibid. "Chemicals Without Harm, Policies for a Sustainable World." Presentation by Ken Geiser.
[29] Ibid. "Chemicals Without Harm, Policies for a Sustainable World." Presentation by Ken Geiser.

    - Shift burden of proof of lower hazard from government to industry.
- **Develop and employ an equity framework** that includes consideration of cumulative risk.
- **Coordinate and collaborate among diverse multi-sector stakeholders** on toxics reduction and chemicals policy reform.
- **Strongly support and incentivize research and development including green chemistry.**

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EQUITY FRAMEWORK

Operationalizing equity

Cumulative Risk and Targeted Universalism are frameworks that can be used together to begin the process of operationalizing equity in toxics reduction work. They provide the theoretical and real-world parameters to design an approach that looks for highest potential for impact by assessing who is the most vulnerable, why and how are they vulnerable, and how to reduce their vulnerability by addressing the context and environment they live within. Cumulative Risk (CR) examines the particulars of a community through the application of a specific framework that examines exposures to several life events at once. Targeted Universalism (TU) takes a more macro-level approach and looks at problems from the population level perspective. This approach suggests focusing efforts on communities most highly impacted, or on those representing the largest disparity, to bring the whole population closer to a universal goal. Used together, CR and TU help identify potential issues of concern and very broadly guide how to address them.

Cumulative Risk and Targeted Universalism are just first steps. Engaging with community partners who may be impacted by potential issues of concern is essential for ultimately selecting priorities and developing solutions. In Metro's case, this last step is guided by the Strategic Plan to Advance Racial Equity, Diversity and Inclusion, which itself was created in collaboration with diverse community partners.[30] The plan focuses on five goals. A - Metro convenes and supports regional partners to advance racial equity. B - Metro meaningfully engages communities of color. C - Metro hires, trains and promotes a racially diverse workforce. D - Metro creates safe and welcoming services, programs and destinations. E - Metro's resource allocation advances racial equity. This work is also guided by Metro's Property and Environmental Services Department Diversity, Equity and Inclusion (DEI) Work Plan, 2018-2020.[31] Lastly and most directly, Metro's work to operationalize equity for reducing community health impacts from chemicals in consumer products is guided by Metro's 2030 Regional Waste Plan, also developed with extensive community involvement.

Targeted Universalism

Targeted Universalism is an approach built from the belief that we share the same "social fabric," are interrelated, and that, as a society, we share a responsibility for the collective good over individual well-being. Therefore the problems of one population, demographic, or community are the problems of all.[32]

From this belief stems an approach: when working towards a universal goal that will improve a broad population, strategies to reach that goal must be targeted and specific to address unique sub-population needs. This embodies an equity approach by understanding the unique barriers and challenges faced by specific populations that may not be met by a broad population-based policy or

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[30] "Metro Strategic Plan to Advance Racial Equity Diversity and Inclusion." Metro, June 2016, https://www.oregonmetro.gov/sites/default/files/2017/10/05/Strategic-plan-advance-racial-equity-diversity-inclusion-16087-20160613.pdf.

[31] Ibid. "Metro's Property and Environmental Services Department Diversity, Equity and Inclusion (DEI) Work Plan..." Metro.

[32] "Targeted Universalism." *Haas Institute for a Fair and Inclusive Society*, Feb. 8 2017, http://haasinstitute.berkeley.edu/targeteduniversalism.

approach. It asks questions that dismantle and separate the various, interlocking structures of our society in order to create targeted strategies intended to benefit vulnerable populations and bring the whole population closer to reaching a universal goal. In theory, this approach has a higher probability of spreading the benefits of the universal goal equally across all groups. TU asks three primary questions[33] to prepare for targeted strategy development:

1. What's the problem?
2. Who suffers the most?
3. How do they suffer?

A universalist approach is akin to the idea of "equality" and doesn't take into account the significant barriers to resources and opportunities some populations experience. For example, universal goals often carry political motivations. They are created to increase efficiency, but they also create the illusion that all Americans, regardless of status or group membership, are on an equal playing field when they are not. And because this idea exists, the general population - policy-makers included - is blind to the fact that some communities need specific assistance because their baseline circumstances are unique and overall insufficient to easily bring them out of the cycle of vulnerability. For these populations, targeted strategies must be put in place in order to ensure that vulnerable populations are not given a blanket or cookie-cutter solution that will better serve and maintain the status quo.[34, 35]

Cumulative Risk

A CR framework is a tool that provides a comprehensive picture of the compounded health effects from both chemical and non-chemical stressors to individuals and a community. Chemical and non-chemical stressors should be considered together, as pieces of a puzzle interacting with one another to gain a clearer image of a community's overall health risk.

Chemical stressors are described as any chemical that is released into the environment that could cause illness or death to people, plants or animals.[36,37] Non-chemical stressors are described as social stresses (related for example to socioeconomic status, race or geographic location) that cause a negative psychosocial response that could affect a person's overall health and well-being.[38]

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[33] "Worksheet: Applying Targeted Universalism to Analyze Impact and Develop People-centered Strategies." Oregon Health Authority, 26 Feb. 2016, http://www.oregon.gov/oha/PH/DISEASESCONDITIONS/CHRONICDISEASE/HPCDPCONNECTION/TRAINING_EVENTS/Documents/TrainingMaterials/2015-2016/02-26-2016_a_worksheet_targeted_universalism.pdf.

[34] "Real Results- Why Strategic Philanthropy is Social Justice Philanthropy." *National Committee for Responsive Philanthropy*, Jan. 2013, https://www.ncrp.org/wp-content/uploads/2016/11/Real_Results_Why_Strategic_Philanthropy_is_Social_Justice_Philanthropy.pdf.

[35] Ibid. "Targeted Universalism." *Haas Institute for a Fair and Inclusive Society.*

[36] "Chemical Stressors." EPA, https://search.epa.gov/epasearch/epasearch?querytext=chemical+stressors&areaname=&areacontacts=&areasearchurl=&typeofsearch=epa&result_template=2col.ftl.

[37] "EPA EcoBox Tools by Stressors – Chemical." EPA, https://www.epa.gov/node/148163/view.

[38] "Non-Chemical Stressors and Cumulative Risk Assessment: An Overview of Current Initiatives and Potential Air Pollutant Interactions." *Environmental Research and Public Health*, 8 June 2011, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3138011/.

Non-chemical stressors are often referred to as "toxic stress," which can be understood in contrast to positive or tolerable stress, and it involves the following: "...strong, frequent, and/or prolonged adversity - such as physical or emotional abuse, chronic neglect, caregiver substance abuse or mental illness, exposure to violence, and/or the accumulated burdens of family economic hardship - without adequate adult support. This kind of prolonged activation of the stress response systems can disrupt the development of brain architecture and other organ systems, and increase the risk for stress-related disease and cognitive impairment, well into the adult."[39]

Toxic stress is important when considering risk for developing disease. Communities that have greater access to resources tend to have a lower risk of negative health outcomes even when exposed to chemical stressors over time because they do not have high levels of toxic stress from non-chemical stressors. Having sufficient resources to live your life with tolerable levels of stress serve as a protective factor against exposure to environmental pollutants, even chronically. For individuals in communities that do experience higher levels of toxic stress, the consistent activation of the natural "fight or flight" response to stress can predispose them to or cause long-term harm.[40]

Chemical and non-chemical stressors don't act in isolation of one another - rather, the stressors compound one another to create an amplified effect.[41] Therefore, in order for a researcher to assess the risk to a community based on exposure to a particular toxin, they also must look at additional potential non-chemical stressors – specifically for exposures rooted in the social determinants of health,[42] such as the level of poverty, the race and ethnicity, the level of education, and the rates of unemployment, etc. – that would act to increase the risk of an individual or community in developing an associated poor health outcome. Race and ethnicity are particularly important indicators to consider as communities of color have increased vulnerability overall because of the stress caused by frequent – if not several times daily – exposures to racism[43] via microaggressions or overt harassment and discrimination. Even the anticipation of discrimination contributes to stress including having to consider how one is perceived in certain circumstances.

While a chemical may be part of CR assessment, cumulative risk looks beyond the chemical stressor to the broader structures that provide or make absent a necessity or resource. Sexton & Linder[44] succinctly describe cumulative risk assessment as "a science-policy tool for organizing and analyzing information to examine, characterize, and possibly quantify combined adverse effects from chemical (e.g., benzene, mercury, polycyclic aromatic hydrocarbons) and non-chemical (e.g.,

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[39] "Toxic Stress." *Center on the Developing Child*, Harvard University, https://developingchild.harvard.edu/science/key-concepts/toxic-stress/.
[40] Ibid. "Toxic Stress." Harvard University.
[41] Ibid. "Environmental health disparities: A framework ..." *Environmental Health Perspectives.*
[42] "Social Determinants of Health." Office of Disease Prevention and Health Promotion, https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health.
[43] "Discrimination Linked to Increased Stress, Poorer Health, American Psychological Association Survey Finds." American Psychological Association, 10 Mar. 2016, http://www.apa.org/news/press/releases/2016/03/impact-of-discrimination.aspx.
[44] "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice." *International Journal of Environmental Research and Public Health*, Nov. 2010, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2996223/.

pollen, noise, microwave radiation, unsafe neighborhoods, unemployment) stressors in the environment."[45]

The EPA lays out a simple conceptual model[46] of identifying potential chemical stressors to a community by beginning with the potential causes—agriculture, urbanization, industry, and mining and resource extraction, for example. By beginning with these potential causes, one can identify the means by which the toxic chemicals could be released into a community. For example, a trash incinerator could release chemicals through the soil, the air, and even through the water if located near a water source. From there, an assessment team or policy-makers can look at the non-chemical stressors that could compound the effects of toxic exposure. Using the trash incinerator example, there is a higher likelihood that it is located in a lower-income community where non-chemical stress levels are more likely to be higher, thus making the community more vulnerable to health risks from chemicals than a higher-income community. A CR assessment would look at all those factors (in much greater detail than laid out in the example) to ensure that the most vulnerable communities are being considered first.

A CR assessment is an applied approach to determine how equity could be created. In particular, the stress-exposure-disease framework (see figure 1 below) provides a means to "understand the relationships among race, environmental conditions, and health."[47] Essentially, CR strives to identify the root causes of health risks to a community and incorporates both the environmental factors, or chemical stressors and the social structures, or the non-chemical stressors to determine why one community would have an increased risk over another.

[45] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice." *International Journal of Environmental Research and Public Health*.
[46] "Sources, stressors and responses: Unspecified Toxic Chemicals - Simple Conceptual Diagram." EPA, https://www.epa.gov/caddis-vol2/caddis-volume-2-sources-stressors-and-responses-unspecified-toxic-chemicals-simple.
[47] Ibid. "Environmental health disparities: A framework..." *Environmental Health Perspectives.*

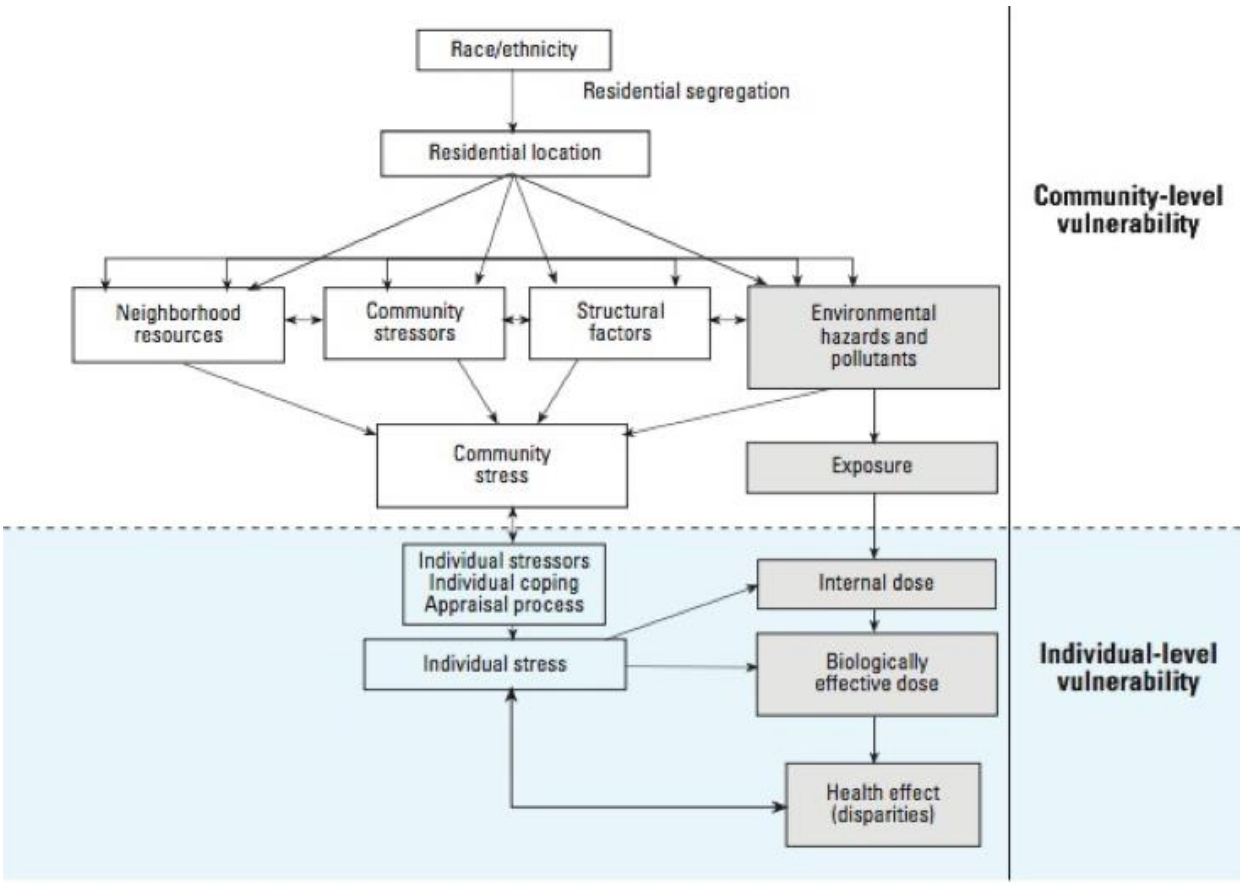

Figure 1. Exposure-disease-stress model for environmental health disparities. From Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts.[48]

By utilizing a CR framework, the compounded risk of chemical exposure to vulnerable communities—whose non-chemical, or toxic stress levels are much higher than higher-income, predominantly white communities—is taken into account and ensures a more comprehensive picture of the exposures, and therefore, pointing to a more comprehensive solution. Specifically, cumulative risk assessment takes into account the vulnerability of a population (i.e., are they more likely to be exposed to or recover from a stressor than others?), the specific details and history of an exposure (i.e., when did the exposure occur and was it intermittent or sequential?), background exposures (i.e., were there other exposures that occurred to increase stressors?), as well as qualitative information and input gathered from the community, as opposed to merely relying on quantitative data.[49]

[48] Ibid. "Environmental health disparities: A framework..." *Environmental Health Perspectives*.
[49] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice." *International Journal of Environmental Research and Public Health*.

Structural barriers

Structural barriers are an important starting point to understanding exposure and subsequent risk. Inherent in both theories and approaches is the belief that there are structural barriers in place that limit the availability and flow of resources to some groups more than others. In some cases, it means that whole communities – due to geography, income status, race, ethnicity, gender, age, and other determinants – are segregated from opportunities via structures that would enable them to reach their full potential.[50,51] Examples include access to the structures of education, health care, jobs, and a world free of racism and discrimination.

> **RACIAL EQUITY**
>
> When race can no longer be used to predict life outcomes, and outcomes for all groups are improved
>
> From Metro's *Strategic plan to advance racial equity, diversity and inclusion*

TU was designed to redirect the conversation to focus on how a population interacts with the structures it exists within. It is built on the premise that we are interconnected and interdependent and that what happens to one community impacts the whole.[52] John powell, the creator of TU, believes the social determinants of health act as unique, independent structures that help determine a person's and their community's level of risk.[53] He discusses race as a primary structure in our society and that by combining the structures of race/ethnicity with other structures, such as residence or geography, the researcher can begin to understand potential root causes of a community's vulnerability.

CR is similar in its view. It says that in order to account for societal structures that enable or block a flow of resources to communities – thus rendering some more vulnerable than others – a risk assessment should be used to look beyond the objective exposure of any one stressor and consider the cumulative impact of several stressors. The CR framework acknowledges that many of the potential stressors are immeasurable or untraceable back to their original source.[54]

Both TU and CR guide the response that ultimately leads the program or policy maker to the root cause of the issue, or the key barriers that must be removed for the flow of the right types of resources to reach groups in need that will ultimately lead to reaching the universal goal.[55]

Engaging with community partners

The most important thing for incorporating equity into policy and program work is to meaningfully engage with communities who have been impacted by the issues one aims to address, and who have historically not had a say in how the issues are addressed. Metro uses several strategies to catalyze

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[50] "Materials from Professor john powell's Webinar on Systems Thinking and Racial Justice." *Leadership Learning Community*, May 18 2011, http://leadershiplearning.org/blog/bcelnik/2011-05-18/slides-professor-john-powells-webinar-systems-thinking-and-racial-justice.

[51] Ibid. "Materials from Professor john powell's Webinar on Systems Thinking and Racial Justice."

[52] Ibid. "Materials from Professor john powell's Webinar on Systems Thinking and Racial Justice."

[53] Ibid. "Materials from Professor john powell's Webinar on Systems Thinking and Racial Justice."

[54] Ibid. "Environmental Health Disparities: A framework..." *Environmental Health Perspectives*.

[55] Ibid. "Materials from Professor john powell's Webinar on Systems Thinking and Racial Justice."

and support meaningful engagement starting with a clear commitment to equity in agency policy, and including fair compensation for community participation and flexibility to remove barriers. Barrier removal takes many forms depending on the situation, and may include financially supporting community based organizations to host meetings in the community, providing childcare and food, and scheduling on evenings or weekends. This work is more of a lived process than a checklist of steps to follow. Meaningful engagement involves building relationships, which take time, and being open to new ideas and new ways of doing things than one initially envisions.

The results of this Study will be used to stimulate conversations with community partners, initially with those who have been involved in the development of the 2030 Regional Waste Plan. The exact process for this and how it would inform the implementation of waste plan actions is yet to be developed.

Metro policies guiding toxics reduction equity engagement work

Equity engagement work at Metro is guided broadly by the Strategic Plan to Advance Racial Equity, Diversity and Inclusion. Toxics reduction equity engagement work is more specifically guided by the 2030 Regional Waste Plan.

The principles of community restoration, partnerships and investment are embodied in the many goals and actions within the 2030 Regional Waste Plan, all developed in close collaboration with community members and partner organizations. These organizations and the Equity Work Group members were hired essentially as consultants to help Metro achieve its equity goals. Forty of the actions in the plan focus directly on advancing equity and reducing disparities.

2030 Regional Waste Plan Principles

Community restoration

- Take action to repair past harms and disproportionate impacts caused by the regional solid waste system. In practice, this means:
- Acknowledging historical impacts passed from generation to generation within communities.
- Actively including communities that have been historically marginalized from decision-making processes.
- Equitably distributing costs and benefits, taking into account historical and system impacts.
- Valuing indigenous and cultural knowledge about using resources sustainably.
- Committing to building a greater awareness of equity among providers of garbage and recycling services.

Community partnerships

- Develop authentic partnerships and community trust to advance the plan's vision. In practice, this means:
- Prioritizing historically marginalized communities within the delivery of programs and services.
- Expanding voice and decision-making opportunities for communities of color.
- Supporting resilient community relationships by creating ongoing opportunities for leadership development.

Community investment

- Emphasize resource allocation to communities of color and historically marginalized communities. In practice, this means:
- Making investment decisions in partnership with communities.
- Investing in impacted communities and youth through education and financial resources.
- Eliminating barriers to services and employment."[56]

The following goals and actions in the 2030 Regional Waste Plan will also help guide community involvement in Metro's toxics reduction and equity work. It is important to note that the term "garbage and recycling" is used here in the context of the full life cycle of products from design and manufacture to consumption and use to end of life management. Each step along a product's life cycle involves chemicals that may cause harm to communities.

Sample equity goals and actions from 2030 Regional Waste Plan

> "**Goal 1:** Increase engagement of youth and adults historically underrepresented in garbage and recycling decision-making by enhancing civic engagement and leadership opportunities.
>
> > **Action 1.1:** Increase representation of historically marginalized community members, including youth, on advisory committees, such as Metro and local government solid waste advisory committees.
> >
> > **Action 1.2:** Evaluate and refine a public sector paid internship program to increase engagement of youth and adults in garbage and recycling careers and decision-making, with an emphasis on communities of color and other marginalized communities.
> >
> > **Action 1.3:** Partner with organizations to engage youth in leadership opportunities for social, economic and environmental issues related to garbage and recycling.

[56] Ibid. "2030 Regional Waste Plan…" Metro, March 2019.

Goal 2: Increase the percentage of garbage and recycling system revenue that benefits local communities and companies owned by people of color and other underrepresented groups.

Goal 3: Ensure that all jobs in the garbage and recycling industry pay living wages and include good benefits.

Goal 4: Increase the diversity of the workforce in all occupations where people of color, women and other historically marginalized communities are underrepresented."[57]

Some questions to consider when discussing toxics reduction actions

The questions below can be used to explore if a proposed action represents strategies that focus on the most vulnerable populations or communities, the structural barriers the populations or communities are up against, the particular type of exposure they are experiencing, and a unique, responsive approach to ameliorating that exposure. These questions are not comprehensive, but rather are meant to stimulate thinking for developing key questions in collaboration with community partners for exploring and assessing specific actions meant to address community health impacts from chemicals in consumer products.

1. What is the specific toxics reduction action?
    - Who will benefit from the action?
    - Is a particular population or community identified as most vulnerable?
    - Will the action have a short/medium/long-term impact (positive or negative) on the population or community?
2. Is (Are) a particular population(s) or community(ies) impacted more than the general population by the chemical/product/system in question?
    - If so, which population(s) or community(ies)?
    - If so, how are they disproportionately impacted?
        - Example: exposure via water, air, skin, etc.
        - Example: proximity in residence, work environment, etc.
        - History of exposure to toxic chemicals (for farm workers families, exposures from home nations, etc.)
3. Does the action consider and address the structural barriers (such as racism and lack of access to education, health care and jobs) and existing (or non-existing) resources available to the population?
    - What are the identified structural barriers?
    - What is the role of income and wealth disparities in these communities that makes them more or less vulnerable?
4. Does the recommendation ameliorate the disparity or gap in accessing resources, the frequency, type or intensity of exposure to the identified vulnerable population(s) or community(ies)?

[57] Ibid. "2030 Regional Waste Plan…" Metro, March 2019.

- If yes, how?
- If not, are there alternatives to the proposed action that would be more inclusive and directed to address vulnerable population(s) or community(ies)?

In the process of refining and using these questions with community partners and other stakeholders, findings from this Study will be used and ongoing work will help to identify specific communities particularly impacted who may be interested in collaborating. It is important to disaggregate the racial data to help identify specific groups to reach out and understand their specific experiences. Ultimately the best equity outcomes come when we can be more precise with our understanding of the disparities and differences among groups. For example some of the research identifies "Asian American" communities as experiencing greater risks. The next step is to find out who in those communities are affected. Asian Pacific Islander communities, or more specifically Pacific Islanders/Marshall Islanders will have a very different history and connection to chemical stressors that say, Vietnamese or Chinese communities.

Transparency, accountability and evaluation

Another key element to equity work is ensuring transparency and accountability to community stakeholders. Participatory Impact Evaluation is an approach adopted by Metro in the Strategic Plan to Advance Racial Equity, Diversity and Inclusion,[58] that involves stakeholders in the evaluation process. Benefits to this approach include increased accountability to the community, opportunities for leadership development and skill building, and enhancement of understanding of the data and findings among community participants.[59,60] Metro continues to build upon and adapt processes based upon the results of ongoing evaluation and community input. It will be necessary to be clear about what is planned to be done with information gathered, and what steps will be taken to incorporate what is learned into decisions. The work planning for this will need to include identification of key decision points and timelines and specific feedback loops back to the communities involved.

[58] Ibid. "2030 Regional Waste Plan…" Metro, March 2019.

[59] Guijt, I. "Participatory Approaches, Methodological Briefs: Impact Evaluation 5." *UNICEF Office of Research*, 2014, Florence, https://www.unicef-irc.org/publications/750-participatory-approaches-methodological-briefs-impact-evaluation-no-5.html.

[60] Zukoski, A. and M. Luluquisen. "Participatory Evaluation: What is it? Why do it? What are the challenges?" *Policy & Practice,* Issue 5, Public Health Institute, 2002. http://depts.washington.edu/ccph/pdf_files/Evaluation.pdf.

CONSUMER PRODUCT REVIEWS

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Community health risk and regulatory context of chemicals in

Apparel and outdoor wear

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: The manufacture of apparel and outdoor wear may include the use of an array of chemicals of concern. This review covers a variety of them including azo dyes, phthalates, solvents, chloroprene and nanosilver, with a particular focus on per- and polyfluoroalkyl substances (PFAS). Health outcomes associated with exposure to one or more of these chemicals of concern - not necessarily specifically from apparel or outdoor wear - include several types of cancer and adverse effects on fetal and child development, on neurologic function and on immune system function. Research suggests infants and textile factory workers have elevated risk.

Regulatory context: The Toxic Substance Control Act is the primary federal regulation affecting chemicals used in apparel manufacture. The Federal Insecticide, Fungicide, and Rodenticide Act regulates pesticides used in clothing and the Consumer Product Safety Improvement Act regulates aspects of children's clothing. There is also legislation at the state level that affects apparel, such as in California, Oregon, Washington and Vermont, including those for children's products specifically and consumer products generally. Several global apparel and retail companies are making changes to their supply chain to voluntarily reduce or eliminate chemicals of concern.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals) and non-chemical stressors (such as from racism or socioeconomic status). For a more detailed description of Cumulative Risk, see the *Equity framework* section.[61]

Textile workers and exposure to multiple chemicals

Textile workers are exposed to a wide variety of chemicals, many of them known carcinogens. Some of these include aromatic amines that result from azo dye degradation and that are linked to

[61] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" *International Journal of Environmental Research and Public Health*.

cancer.[62] Other dyes, solvents such as Dimethylformamide (DMF), optical brighteners, finishing agents, and natural and synthetic fibers may also affect worker health.[63] In a meta-analysis that reviewed 54 articles, researchers were able to discern various exposure pathways within several types of textile production operations and facilities and potential health outcomes associated. Overall, they found high incidence of several types of cancers in textile workers.[64]

> *"After going through the available reports, it can be concluded that workers under varied job categories in textile industries are at a higher risk of developing cancer as various chemicals used in the textile industry are toxic and can act as potential health risk in inducing cancer among them. Assessing the cancer risk at different job levels in textile industries may be found useful in assessing the overall risk to the workers and formulating the future cancer preventive strategies".*[65]

Previous studies reported that cotton textile workers have a higher incidence of lung cancer than textile workers producing other types of textiles due to exposure to endotoxin. New research from a meta-analysis examining articles spanning 39 years (1976-2015) to draw more clear associations between textile workers, chemical exposures and cancer risk, shows that endotoxin may actually have a "protective factor" against lung cancer for cotton textile workers. "Bacterial endotoxin which is a contaminant of raw cotton fibre and cotton dust, has been proposed as a protective agent against cancer. The action of endotoxin may be through the innate and acquired immune systems. Long-term and high-level exposure to endotoxin, compared with no exposure was found to be associated with a reduced risk of lung cancer..." While endotoxin is thought to serve as a protective factor for cotton workers against lung cancer, "mortality risk from gastrointestinal cancers and all cancers combined… were increased" compared to other textile production workers.[66]

Dimethylformamide (DMF), is a solvent used in several textile production facilities including, "acrylic fiber spinning" and is also present in "textile dyes and pigments."[67] It is readily absorbed through the skin, and can also be inhaled, or ingested. In 1983 NIOSH estimated 100,000 U.S. workers are exposed to DMF annually, though it is unclear how many of those work in the textile industry as DMF is also used in other capacities. The Centers for Disease Control and Prevention (CDC) reports DMF is a potent liver toxin, known to cause skin problems, and may cause abdominal pain, constipation, nausea and vomiting, headache, weakness, dizziness, skin problems and alcohol intolerance.[68] DMF is also embryotoxic in animals with exposures resulting in reduced implantation efficiency, decreased mean fetal weight, increased abortions, and malformed fetuses with high

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[62] Nguyen, T., Saleh, M. A. "Detection of azo dyes and aromatic amines in women under garment." *Journal of Environmental Science and Health*, Part A Toxic/hazardous substances & environmental engineering, 28 Jul. 2016, https://www.ncbi.nlm.nih.gov/pubmed/27149414.
[63] Ibid. "Detection of azo dyes and aromatic amines..." *Journal of Environmental Science and Health*.
[64] Singh, Zorawar and Pooja Chadha. "Textile Industry and Occupational Cancer." *Journal of Occupational Medicine and Toxicology,* 15 Aug. 2016, www.occup-med.biomedcentral.com/articles/10.1186/s12995-016-0128-3.
[65] Ibid. Singh, Zorawar and Pooja Chadha. "Textile Industry and Occupational Cancer."
[66] Ibid. Singh, Zorawar and Pooja Chadha. "Textile Industry and Occupational Cancer."
[67] "Preventing Adverse Health Effects from Exposure to: Dimethylformamide (DMF)." Centers for Disease Control, Sep. 1990, www.cdc.gov/niosh/docs/90-105/.
[68] Ibid. "Preventing Adverse Health Effects from Exposure to: Dimethylformamide (DMF)." Centers for Disease Control.

exposure to DMF. Research suggests a possible association between DMF exposure and testicular cancer.[69]

General population and several chemicals in garments

The research contained in this report uses several terms and abbreviations as used by the source articles. In 2012, Greenpeace tested garments from global fashion brands to find that several had levels of chemicals identified in the European Union as "toxic" to "very toxic" to aquatic organisms. Several of the chemicals are also chemicals of concern to human health. All of the samples with plastisol-printed fabric (31) tested positive for phthalates. Phthalate exposure is widespread from many consumer product sources and at higher levels than found in the garments, phthalates are linked to cancer and reproductive abnormalities, including reduced sperm count and testicular atrophy. Two garments contained carcinogenic amines from azo dyes.[70, 71]

Distinguishing between PFC, PFAS, PFOS, and PFOA[72]

The term "perfluorinated chemicals" or the abbreviation PFCs is often used when referring to PFOA, PFOS and other per- and polyfluoroalkyl substances (PFASs). The EPA is trying to use "per- and polyfluoroalkyl substances (PFASs)" rather than "perfluorinated chemicals (PFCs)" consistently to collectively describe PFOA, PFOS and the other chemicals in this group." The EPA adds the following regarding the distinction between these terms and chemical classes:

"The other "PFCs" - perfluorocarbons - is a group of chemicals closely related to PFASs that share common features with PFASs:

- Both perfluorocarbon and PFAS molecules contain fluorine and carbon atoms
- Both persist in the environment for long periods.
- PFASs are not found naturally in the environment. The same is true for perfluorocarbons, with the exception that small amounts of one perfluorocarbon, carbon tetrafluoride, are emitted from granite.

Perfluorocarbons, however, are quite different from PFASs in significant respects:

- Unlike PFAS molecules, which can include oxygen, hydrogen, sulfur and/or nitrogen atoms, perfluorocarbon molecules contain only carbon and fluorine atoms.
- Perfluorocarbons are used in and emitted from different applications and industries than PFASs are."

In this Study, "PFAS" will be used to refer to per- and polyfluoroalkyl substances unless the research cited uses another term. "PCF" will be used in those cases to refer to perfluorinated chemicals, not to perfluorocarbons.

[69] "EPA Hazard Summary N,N-Dimethylformamide." Environmental Protection Agency, Sep. 2016, www.epa.gov/sites/production/files/2016-09/documents/n-n-dimethylformamide.pdf.

[70] "Toxic Threads: The Big Fashion Stitch-Up." Greenpeace International, 20 Nov. 2012, www.greenpeace.org/international/publication/6889/toxic-threads-the-big-fashion-stitch-up/.

[71] Chau, Jasmin Malik. "Greenpeace Exposes Toxic Chemicals in Zara, Other Fast-Fashion Brands." *Ecouterre*, 21 Nov. 2012, www.inhabitat.com/ecouterre/greenpeace-exposes-toxic-chemicals-in-zara-other-fast-fashion-brands/.

[72] "What are PFCs and How Do They Relate to Per- and Polyfluoroalkyl Substances (PFASs)?" Environmental Protection Agency, July 2017, https://www.epa.gov/pfas/what-are-pfcs-and-how-do-they-relate-and-polyfluoroalkyl-substances-pfass.

General population and PFAS

Apparel (and a wide array of other consumer products) commonly contain stain-resistant and water repellent fluorinated chemicals generally known PFAS or PFCs (see above for distinction of terms). PFAS are a large group of persistent, manufactured compounds used to make a range of products water, stain and grease resistant such as clothing, tablecloths, car seats, upholstery, jackets, shoes, tents and more. Textiles account for half of U.S. sales of PFCs.[73] In a study of PFC levels in outdoor clothing and gear from a variety of major brands, Greenpeace found PFCs in all or most of the products tested.[74]

PFCs can contaminate house dust from routine wear and tear and any type of cleaning which can dislodge chemicals into the air causing them to settle into house dust. Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), two types of PFCs, are no longer produced in the U.S. after a voluntary phase out by leading manufacturers, but they can still be imported into the U.S. in consumer goods sold here. Also, their presence remains ubiquitous as the products they were incorporated into degrade, are discarded, or release PFOA into the environment in other ways.[75,76]

Human toxicological studies have revealed that PFOS and PFOA (two PFASs) are readily absorbed via oral exposure and that they accumulate primarily in the serum, kidney and liver.[77] Once in the human body PFOS and PFOA have a half-life ranging from 2 to 9 years.[78] Researchers predict that the prolonged internal presence of these compounds - from any source - increases body burden and risk for adverse health outcomes. The health outcomes associated with exposure to individual PFCs or a combination of them are still being researched. The CDC compiled human and animal studies to understand the health impacts of PFCs (including PFOA, PFOS, and others). There is compelling evidence of an association between exposure to these chemicals and several health concerns, including: "high cholesterol (hypercholesterolemia), ulcerative colitis, thyroid dysfunction, testicular cancer, kidney cancer, preeclampsia, as well as elevated blood pressure during pregnancy,"[79] and uric acid.[80]

The Agency for Toxic Substances and Disease Registry shared findings from a comprehensive review of studies that examined health outcomes associated with exposure to perfluoroalkyls, which they define as containing 14 separate chemical structures:[81]

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[73] "Poisoned Legacy: Where Consumers Encounter PFCs Today." Environmental Working Group, 1 May 2015, www.ewg.org/research/poisoned-legacy/where-consumers-encounter-pfcs-today#.WvDYPNMvzOQ.
[74] "Leaving Traces: The Hidden Hazardous Chemicals in Outdoor Gear." Greenpeace, 2016, https://storage.googleapis.com/planet4-international-stateless/2016/01/d9343da2-leaving-traces.pdf.
[75] "Perfluorinated Chemicals (PFCs)." National Institute of Environmental Health Sciences, July 2016, www.niehs.nih.gov/health/materials/perflourinated_chemicals_508.pdf.
[76] "Basic Information on PFAS." Environmental Protection Agency, www.epa.gov/pfas/basic-information-pfas.
[77] "Environmental Protection Agency." *Federal Register*, 10 Mar. 2006, www.gpo.gov/fdsys/pkg/FR-2006-03-10/pdf/E6-3444.pdf.
[78] "Emerging Contaminants Fact Sheet—PFOS and PFOA." Environmental Protection Agency, March 2014, www.nepis.epa.gov/Exe/ZyPDF.cgi/P100LTG6.PDF?Dockey=P100LTG6.PDF.
[79] "An Overview of Perfluoroalkyl and Polyfluoroalkyl Substances and Interim Guidance for Clinicians Responding to Patient Exposure Concerns." Centers for Disease Control, 7 June 2017, www.atsdr.cdc.gov/pfc/docs/pfas_clinician_fact_sheet_508.pdf.
[80] Ibid. "An Overview of Perfluoroalkyl and Polyfluoroalkyl Substances." Centers for Disease Control, 2017.
[81] "Toxicological Profile for Perfluoroalkyls: Draft for Public Comment, Chapter 2, Health Effects." Centers for Disease Control, Agency for Toxic Disease Registry, August 2018, https://www.atsdr.cdc.gov/toxprofiles/tp200-c2.pdf.

- Impacts on immune system function
- Liver damage
- Pregnancy induced hypertension or preeclampsia
- Lower a woman's chance of getting pregnant
- Decreased birth weight

Pregnant women, fetuses, and infants and PFAS

Pregnant women and fetuses are sensitive subpopulations because of transplacental migration of chemicals and the vulnerability of the rapidly developing fetus. Breastfed infants are susceptible to increased exposures to PFAS in breast milk, because breastfeeding is a route of PFAS excretion for lactating women.[82] Several studies have found an association between increased levels of PFAS (primarily PFOS and PFOA) prenatally and in utero and lower birth weight. One systematic review "suggests that each 1 ng/mL increase in prenatal PFOA levels is associated with up to 18.9 g reductions in birth weight.[83]

New research by the Minnesota Department of Health related to PFAS contaminated groundwater has found that "The accumulation of some PFAS in women of childbearing age, and the placental and breastmilk transfer to their offspring, require new risk assessment methods to protect public health… Even short exposures during infancy have dramatic impacts on serum levels for many years. In addition, developmental effects are the critical effects anchoring recent risk assessments... Peak breastfed infant serum levels were 4.4-fold higher than in formula-fed infants, with both of these scenarios producing serum levels in excess of the adult steady-state level."[84] Department of Health staff involved in the study were careful to point out that these findings do not suggest that concerns about PFAS in breastmilk outweigh the benefits of breastfeeding, which is itself a health equity issue.

For small children, PFC serum levels are elevated by the frequency of use of waterproof clothing, frequency of consumption of PFC containing foods and food packaging, and household dust concentrations.[85]

Chemicals of concern in children's clothes

A 2014 report by the Greenpeace Research Lab out of University of Exeter in London found that chemicals of concern were found in children's clothes from a variety of popular brands. They tested for five main chemical types: phthalates, nonylphenol ethoxylates (NPEs), per- and poly-fluorinated chemicals (PFCs), organotins, and antimony. NPEs were found in 50 of the 82 products tested. Phthalates were detected in 33 of the 35 samples relevant for the particular materials in the

[82] Romano, Megan, et al. "Maternal Serum Perfluoroalkyl Substances During Pregnancy and Duration of Breastfeeding." *Environmental Research*, 11 May 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC4907828/.
[83] Ibid. "An Overview of Perfluoroalkyl and Polyfluoroalkyl Substances." Centers for Disease Control, 2017.
[84] "A transgenerational toxicokinetic model and its use in derivation of Minnesota PFOA water guidance." *Journal of Exposure Science & Environmental Epidemiology,* 2019, https://www.nature.com/articles/s41370-018-0110-5.
[85] Wu, Xiangmei, et al. "Serum Concentrations of Perfluorinated Compounds (PFC) among Selected Populations of Children and Adults in California." *Environmental Research*, Jan. 2015, www.sciencedirect.com/science/article/pii/S0013935114003363.

product. PFCs were found all 15 of the articles relevant based on their material composition. The tested products were purchased in 25 different countries.[86]

General population, chloroprene and occupational exposure

Chloroprene is the chemical used to make neoprene, a common waterproofing agent for outerwear and wetsuits. Denka Performance (formerly known as Dupont) is the only manufacturer of neoprene in the U.S. Their factory is located in Louisiana. People in the five census tracts surrounding the plant have more than 700 times the national average for risk of developing cancer, which is the highest in the country, due to chloroprene emissions from the Denka plant, based on National Air Toxics Assessment screening tool data.[87,88]

Chloroprene exposure - at higher rates than would be encountered wearing neoprene - is associated with several poor health outcomes: "...short term exposure to high concentrations can affect the nervous system (e.g., headache, irritability, dizziness), the heart (rapid heartbeats), gastrointestinal disorders, dermatitis, temporary hair loss, corneal damage. It may also affect the lung, liver, kidneys and the immune system. Long-term exposure to chloroprene has been reported to cause respiratory, eye and skin irritation, chest pains, temporary hair loss, neurological symptoms (e.g., dizziness, insomnia, headaches) and fatigue in occupationally exposed workers. Effects in the cardiovascular system (rapid heartbeat, reduced blood pressure) and changes in blood cell parameters (red blood cells, hemoglobin content, white blood cells, and platelets) have also been reported in occupationally exposed workers. Long-term exposure to chloroprene has also been associated with increase in the risk of developing cancer." [89]

Divers, underwater workers or others that wear neoprene based wetsuits for long periods have reported contact dermatitis.[90] Neoprene absorbs chemicals from its environment, acting like a sponge in contaminated waters. These chemicals have been found to actively degrade neoprene, making the diver vulnerable to absorption of both chloroprene and the contaminants in the water.[91]

General population and nanosilver

Nanosilver is a more recently developed chemical used as an antimicrobial agent to inhibit odor-causing bacteria in clothing. Exposure occurs through inhalation, skin absorption or ingestion.[92] Preliminary animal studies have found that silver nanoparticles can traverse into the brain, and can induce neuronal degeneration and necrosis (death of cells or tissue) by accumulating in the brain

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[86] "Greenpeace Study Finds Hazardous Chemicals in Children's Clothing from a Wide Range of Well-known Brands." Greenpeace, Jan. 2014, www.greenpeace.org/italy/Global/italy/report/2013/toxics/Little_Story_about_the_Monsters_in_Your_Closet.pdf.

[87] Hersher, Rebecca. "After Decades Of Air Pollution, A Louisiana Town Rebels Against A Chemical Giant." *National Public Radio*, 6 Mar. 2018, www.npr.org/sections/health-shots/2018/03/06/583973428/after-decades-of-air-pollution-a-louisiana-town-rebels-against-a-chemical-giant.

[88] "Laplace, LA Frequently Asked Questions." Environmental Protection Agency, www.epa.gov/la/laplace-louisiana-frequent-questions.

[89] Ibid. "Laplace, LA Frequently Asked Questions." Environmental Protection Agency

[90] "Contact Dermatitis in Divers." *Wiley Online Library*, Aug. 1982, www.onlinelibrary.wiley.com/doi/full/10.1111/j.1600-0536.1982.tb04222.

[91] "Protection of Divers in Waters that are Contaminated with Chemicals or Pathogens." Environmental Protection Agency Archive, 1991, www.archive.epa.gov/region10/diving/web/pdf/protection_of_divers_epa_article.pdf.

[92] Behra, Renata et al. "Bioavailability of silver nanoparticles and ions: from a chemical and biochemical perspective" *Journal of the Royal Society, Interface,* Vol. 10, 6 Oct. 2013, https://royalsocietypublishing.org/doi/full/10.1098/rsif.2013.0396.

over a long period of time.[93] Consumer exposure to nanosilver depends on the location of the nanomaterial in consumer or medical products and the manipulation of the product. To determine the level of exposure, more information is needed on the concentrations of silver in products, the size and the form in which it is present and the probability of release of silver nanoparticles (Ag-NPs) or silver (Ag) ions from the products. In vitro, genotoxic effect of nanosilver has been reported. The main targets of nanosilver are the immune system, liver, spleen and kidney.[94]

Federal regulatory context

Several federal agencies administer regulations associated with chemicals used in apparel production. The most relevant is the Toxic Substances Control Act (TSCA) which is administered by the Environmental Protection Agency (EPA) and as amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act, provides EPA with the authority to prohibit or limit the manufacture, processing, distribution in commerce, use or disposal of a chemical if EPA evaluates the risk and concludes that the chemical presents an unreasonable risk to human health or the environment. EPA catalyzed the voluntary phase out of PFOS and PFOA from most uses in the U.S. through the PFOA Stewardship Program, and has issued Significant New Use Rules (SNURs) for hundreds of PFASs (and other chemicals) since 2000.[95,96]

Manufacturers must also comply with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) if products contain pesticides. Chemicals that kill or repel bacteria or other germs are considered pesticides, and must be registered with the EPA and labeled appropriately prior to distribution or sale.

Regulation of children's products is primarily managed by the Consumer Product Safety Commission (CPSC) under the Consumer Product Safety Improvement Act (CPSIA) which includes specific substances such as flame retardants, lead and phthalates in children's apparel and sleepwear (see *Children's products* for detail). The CPSC's Flammable Fabric Act establishes standards for the flammability of clothing textiles, vinyl plastic film (used in clothing) and children's sleepwear.[97,98]

State action on a chemical is preempted when EPA finds (through a risk evaluation) that the chemical is safe or takes final action to address the chemical's risks. State action on a chemical is temporarily "paused" when EPA's risk evaluation on the chemical is underway, but lifted when EPA

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[93] "Nanosilver: Health Effects." *Beyond Pesticides*, www.beyondpesticides.org/programs/antibacterials/nanosilver/health-effects.

[94] Hartemann, Phillippe, et al. "Nanosilver: Safety, Health and Environmental Effects and Role in Antimicrobial Resistance." *Materials Today,* Mar. 2015, www.researchgate.net/publication/273261364_Nanosilver_Safety_health_and_environmental_effects_and_role_in_antimicrobial_resistance.

[95] "Fact Sheet: 2010/2015 PFOA Stewardship Program." Environmental Protection Agency, 9 Jan. 2019, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program.

[96] "Risk Management for Benzidine Dyes." Environmental Protection Agency, 9 Jan. 2019, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-benzidine-dyes.

[97] "A Guide to United States Apparel and Household Textile Compliance Requirements." National Institute of Standards and Technology, Apr. 2016, https://www.cpsc.gov/s3fs-public/Guide-to-US-Apparel-and-Household-Textiles.pdf?Uy5dQwgi41YbPckmAjj265aT8iK31MCK.

[98] "Flammable Fabric Act." United States Consumer Product Safety Commission, 11 Jan. 2019, https://www.cpsc.gov/Regulations-Laws--Standards/Statutes/Flammable-Fabrics-Act/.

completes the risk evaluation or misses the deadline to complete the risk evaluation. States can apply for waivers from both general and "pause" preemption. If certain conditions are met, EPA may grant an exemption from general preemption.[99]

For more information on TSCA, please see the *Regulatory context* section and *Appendix 1: Federal regulation history and structure*.

Western U.S. regulatory context and local action

Legislation at the state level that affects apparel has been passed in Oregon, Washington and California as well as in Vermont, including those for children's products specifically and consumer products generally.

Oregon

The Oregon Legislature passed the Toxic-Free Kids Act in 2015. The law requires manufacturers to report specific categories of products containing high priority chemicals of concern for children's health.[100] The definition of children's products that is required under ORS 431A.250 is narrowly defined as products made for, marketed for use by or marketed to children under 12 years of age including products "designed or intended by the manufacturer to facilitate sucking, teething, sleep, relaxation, feeding or drinking, children's clothing and footwear, car seats, children's cosmetics, children's jewelry and toys, with some exclusions"[101] Under ORS 431A.253, those products containing High Priority Chemicals of Concern for Children's Health (HPCCCH) above the determined thresholds must be reported.[102] The law also requires manufacturers to remove these chemicals from certain product categories or seek a waiver. This law is based largely on Washington's Children's Safe Product Act, using Washington's initial list of priority chemicals.

According to one Oregon Health Authority staff member, state chemicals disclosure requirements may do more than identify products that need to be removed from the market. They likely also motivate U.S. based retailers and manufacturers to better understand the chemical composition of their products and components through queries of their upstream overseas suppliers.

Washington

In 2008, the *Children's Safe Products Act*[103] was passed (HB2647) to limit the use of lead, cadmium, and six phthalates in children's products sold in Washington, limit the use of flame retardants in children's products (e.g. clothing) and upholstered furniture, and requires manufacturers to report the use of Chemicals of High Concern to Children[104] in their children's products. Stemming from this legislation, in 2011 (and updated in 2017), Washington adopted the Children's Safe Products

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[99] "Highlights of Key Provisions in the Frank R. Lautenberg Chemical Safety for the 21st Century Act." Environmental Protection Agency, www.epa.gov/assessing-and-managing-chemicals-under-tsca/highlights-key-provisions-frank-r-lautenberg-chemical.
[100] "High Priority Chemicals of Concern for Children." Oregon Health Authority, www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/TOXICSUBSTANCES/Pages/childrens-chemicals-of-concern.aspx.
[101] "ORS 431A.250." Oregon Legislature, www.oregonlegislature.gov/bills_laws/ors/ors431a.html.
[102] "ORS 431A.253." Oregon Legislature, www.oregonlegislature.gov/bills_laws/ors/ors431a.html.
[103] "Children's Safe Products Act." Washington State Department of Ecology, www.ecology.wa.gov/Waste-Toxics/Reducing-toxic-chemicals/Childrens-Safe-Products-Act.
[104] "Chemicals of High Concern Reporting." Washington State Department of Ecology, www.ecology.wa.gov/Regulations-Permits/Reporting-requirements/Reporting-for-Childrens-Safe-Products-Act/Chemicals-of-high-concern-to-children.

Reporting Rule[105] which defined the list of chemicals, established manufacturers' compliance rules, and clarified the enforcement processes.

Washington State has passed (or is currently considering) the following legislation related to children's products:

- SB 6248[106] passed in 2009 (enacted in 2010) to ban BPA from children's food and beverage containers (other than metal cans) and all reusable water bottles.
- HB 2545 / SB 6440[107] passed in 2016 to ban the sale of children's products and residential furniture containing toxic flame retardants (TDCPP and TCEP).
- HB 2632 would prohibit the sale of children's products and upholstered furniture that contain organohalogen flame retardants and would require the disclosure of high priority chemicals in children's products, including electronics. Currently the manufacturers are only required to report the use of high priority chemicals. This legislation would actively prohibit the use of those chemicals in children's products. This appears to be an update to prior legislation as previously the law only required the reporting of the chemicals and fell short of actively banning them from products. This legislation would take this a step farther which is similar to Oregon's Toxic Free Kids Act. It was deferred until an introductory report was adopted in the 2018 legislative session in WA.[108]

California

Proposition 65

In 1986, California Proposition 65[109] was a voter-approved initiative that eventually led to the Safe Drinking Water and Toxic Enforcement Act of 1986, requiring the state to publish a list of chemicals known to cause cancer.[110] Proposition 65 is a consumer "right to know" law. It affects the apparel industry by requiring businesses selling products in California (in stores, catalogs, or online) to contain a warning label if it contains any of the chemicals on the published list of chemicals.[111]

Safer Consumer Products Program

California launched the Safer Consumer Products (SCP) Program[112] in 2013, a green chemistry initiative with the goal of reducing toxic chemical exposure from everyday product use to promote

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[105] "Children's Safe Product Reporting Rule." Washington State Department of Ecology, www.fortress.wa.gov/ecy/publications/SummaryPages/1704022.html.

[106] "Washington SB 6248." Washington State Legislature, 2009, http://lawfilesext.leg.wa.gov/biennium/2009-10/Pdf/Bills/Senate%20Passed%20Legislature/6248-S.PL.pdf#page=1.

[107] "Washington State 2545 / SB 6440." Washington State Legislature, 2016, http://lawfilesext.leg.wa.gov/biennium/2015-16/Pdf/Bills/House%20Passed%20Legislature/2545-S.PL.pdf#page=1.

[108] "Washington State HB 2632." Washington State Legislature, 2017, http://lawfilesext.leg.wa.gov/biennium/2017-18/Pdf/Bill%20Reports/House/2632%20HBA%20ENVI%2018.pdf.

[109] "Prop 65 Plain Language." Office of Environmental Health Hazard Assessment, 1 Feb. 2013, http://oehha.ca.gov/proposition-65/general-info/proposition-65-plain-language.

[110] "OEHHA Chemicals Considered under Prop 65." Office of Environmental Health Hazard Assessment, http://oehha.ca.gov/proposition-65/chemicals.

[111] Spirito, Louann. "The Effects of Proposition 65 on the Apparel Industry." SGS Consumer Testing Services, Jan. 2012, www.sgs.com/~/media/Global/Documents/White%20Papers/sgs-consumer-products-testing-prop-65-sl-whitepaper-en-12.ashx.

[112] "Safer Consumer Products Program." California Department of Toxic Substances Control, https://calsafer.dtsc.ca.gov/.

the development and technology around greener products. The process the program takes includes the following:[113]

1. SCP identifies which chemicals pose health or environmental hazards.
2. SCP identifies the products that contain the chemicals. These are called "Priority Products."[114]
3. The companies that make Priority Products will evaluate their use of hazardous chemicals in their products by using the Alternative Analysis process, which involves examining safer alternatives to chemicals of concern.[115]
4. SCP issues a regulatory response.
5. Companies make adjustments to the products based on the regulatory response requirements.[116]

Industry initiatives

Nike, Columbia, Adidas and other brands advancing green chemistry

Nike has pledged to eliminate toxic chemicals from their supply chain,[117] is working on a complete phase-out of PFC-based finishes by 2021, and has included green chemistry as a part of their commitment.[118] Adidas and Columbia[119] are both members of the Outdoor Industry Association (see below) and have chemical management programs detailed on their websites.[120,121] Patagonia has developed a Chemical and Environmental Impacts Program (CEIP) to manage chemicals in their supply chain.[122] While not expressly a part of their company's mission like Patagonia, both H&M and Levi's[123] have also pledged to eliminate toxic chemicals from their supply chains.[124]

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[113] Singla, Veena. "New California Program is on a Mission to Reduce Toxic Chemicals in our Everyday Products." *NRDC*, 27 Apr. 2015, www.nrdc.org/experts/veena-singla/new-california-program-mission-reduce-toxic-chemicals-our-everyday-products.
[114] "What is a Priority Product?" California Department of Toxic Substances Control, https://dtsc.ca.gov/what-is-a-priority-product/.
[115] Singla, Veena. "Selecting Safer Alternatives To Toxic Chemicals And Ensuring The Protection Of The Most Vulnerable: A Discussion." *NRDC*, June 2017, www.assets.nrdc.org/sites/default/files/toxic-chemicals-vulnerable-populations-report.pdf?_ga=2.255808833.875235091.1524604004-548118320.1524604004.
[116] "Final 2018-2020 Priority Product Work Plan." California Department of Toxic Substances Control, 2018, https://dtsc.ca.gov/scp/priority-product-work-plan/.
[117] "Nike Roadmap to Zero Discharge of Hazardous Chemicals." *Nike News*, 18 Nov. 2011, www.news.nike.com/news/nike-roadmap-toward-zero-discharge-of-hazardous-chemicals.
[118] "Nike Green Chemistry." Green Chemistry and Commerce Council, www.greenchemistryandcommerce.org/downloads/Nike_final.pdf.
[119] "OIA members." *Outdoor Industry Association*, www.outdoorindustry.org/who-we-are/our-members/.
[120] "Adidas Chemical Management Program." Adidas, www.adidas-group.com/en/sustainability/products/chemical-footprint/.
[121] "Responsible Manufacturing." Columbia, www.columbia.com/About-Us_Corporate-Responsible_Manufacturing.html; "Corporate Responsibility." Columbia, www.columbia.com/on/demandware.static/-/Sites-Columbia_US-Library/default/dw3390eee3/AboutUs/PDF/2015_Columbia_.Corp_Resp_Report_FINAL.pdf.
[122] "Working With Mills." Patagonia, www.patagonia.com/working-with-mills.html.
[123] "Commitment to Zero Discharge of Hazardous Chemicals." Levi's, www.levistrauss.com/wp-content/uploads/2014/01/Commitment-to-Zero-Discharge-of-Hazardous-Chemicals.pdf.
[124] Chua, Jasmin Malik. "H&M to Eliminate Chemicals from Supply Chain." *Ecouterre*, www.inhabitat.com/ecouterre/hm-pledges-to-eliminate-toxic-chemicals-from-supply-chain-by-2020/.

AFIRM group

"AFIRM is a working group of leading brands in the apparel, footwear and sporting goods industries working to harmonize product chemical requirements in a precompetitive space. With facilitation by the Phylmar Group, AFIRM maintains product and packaging Restricted Substances Lists (RSLs), publishes guidance and provides training on restricted substances to the greater supply chain, and engages policymakers with responsible industry positions on restricted substances in products."[125] Members include Nike, Adidas, Gap Inc., Amazon, Levi's and many others.

Outdoor Industry Association

The Outdoor Industry Association (OIA)[126] is a trade organization made up of over 1,200 members who represent the retail industry (manufacturing, sales, suppliers, etc.), nonprofits, and "outdoorists." Because of their specific commitment and advocacy for sustainability while also representing the economic interests of their members, they are a model for working on the supply chain side of outdoor apparel manufacturing. The OIA has a chemicals management program that advocates for and works with the industry to "ensure safe and sustainable products throughout the supply chain."[127] OIA resources include a comprehensive toolkit advising companies and brands on how and why to include a chemicals management program.[128]

Zero Discharge of Hazardous Chemicals Programme

The ZDHC Roadmap to Zero Programme supports the elimination of the use of priority hazardous chemicals by over 100 brands and value chain affiliates including Puma, Gap, Levi Strauss & Company, Nike, H&M and Target. Their tools and academy foster safer chemical management practices through Manufacturing Restricted Substances List (MRSL) & Conformity Guidance, Wastewater Quality, Audit Protocol, Research, Data and Disclosure, and Training.[129]

The Sustainable Apparel Coalition

"The Sustainable Apparel Coalition is the apparel, footwear and textile industry's leading alliance for sustainable production. The Coalition develops the Higg Index, a standardized supply chain measurement suite of tools for all industry participants. These tools measure environmental and social labor impacts across the supply chain. With this data, the industry can address inefficiencies, resolve damaging practices, and achieve the environmental and social transparency consumers are demanding. By joining forces in a Coalition, we can address the urgent, systemic challenges that are impossible to change alone."[130] A vast array of leading brands and supply chain affiliates are members of the Sustainable Apparel Coalition.

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[125] "AG AFIRM GROUP." Phylmar Group, 9 Jan. 2019. https://www.phylmar.com/afirm/.
[126] "Home Page." *Outdoor Industry Association*, www.outdoorindustry.org.
[127] "Chemicals Management." Outdoor Industry Association, www.outdoorindustry.org/sustainable-business/chemicals-management/.
[128] "Getting Started Guide for Chemicals Management Program." *Outdoor Industry Association*, www.outdoorindustry.org/wp-content/uploads/2015/03/Chemical-Management-v2-1.pdf.
[129] "Zero Discharge of Hazardous Chemicals Programme." ZDHC, 10 Jan. 2019, https://www.roadmaptozero.com/.
[130] "The Sustainable Apparel Coalition." 10 Jan. 2019, https://apparelcoalition.org/the-sac/.

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Community health risk and regulatory context of chemicals in

Building materials

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: The greatest impacts to human health in buildings are related to indoor air pollution, which the EPA characterized in 1991 as "one of the greatest threats to public health of all environmental problems." A study released in early 2018 found that everyday chemicals - indoor cleaners, personal care products, paints, etc. - are increasingly becoming major sources of outdoor air pollution. Indoor air pollution is of particular importance because people in the United States now spend 90 percent of their time in indoor spaces - including homes, offices, schools and hospitals. Multifamily buildings pose unique indoor air quality challenges because pollutants may move from unit to unit and residents have limited ability to make changes to the building structure itself. All populations are susceptible to the myriad chemical and exposure pathways present in building materials and design in various indoor environments. Students, teachers and staff in schools may have increased exposure to PCBs and other pollutants in the school environment. Construction workers are exposed to numerous chemicals via building materials, with several health outcomes associated with the exposures.

Regulatory context: The chemical constituents in building materials are federally regulated primarily under the Toxic Substances Control Act. Legislation and other initiatives have been enacted in Oregon to improve building and demolition practices. California's CALGreen Code and Safer Consumer Products Program both aim in part to reduce the use of chemicals of concern in building materials.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals)

and non-chemical stressors (such as from racism or socioeconomic status).[131] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

The primary focus here is on potential impacts on residents and on the construction workforce. There is also additional information on construction materials exposure related to silica and asbestos in the *Workplace exposures in the service sector* section. Lead is a chemical of high concern, but is discussed here only in relation to demolition policies. Mold and radon are also significant concerns but are not treated in this Study.

Asthma, race and hardship

While not directly connected to chemicals in building materials, findings from the following study underscore the relationship between socioeconomic factors and health outcomes. Households with poor housing quality had 50 percent higher odds of an asthma-related ED visit in the past year. Black households are more likely to have children with asthma and asthma-related ED visits than their white counterparts, for factors incompletely explained by "traditional measures of socioeconomic status, income and education."[132] When they controlled for more nuanced life circumstances they discovered "housing quality and home ownership" were two factors that had strong, independent associations with "asthma diagnosis and ED visits," and lessened the racial disparities. Poor housing quality (defined as "the presence of any of the following—cracks in walls/floors/windows, broken plumbing, or exposed wires") had "a 50 percent higher odds of an asthma-related ED visit in the past year, while home ownership conveyed an almost 40 percent lower odds of an ED visit, even after adjusting for housing quality and the presences of housing related exposures known to be associated with asthma (household pests, mold, and cigarette smoke exposure). Together, these findings suggest that poor housing quality and lack of home ownership may partially mediate racial/ethnic disparities in asthma outcomes, and support the idea that poor housing quality could be targeted to reduce asthma-related health disparities in children."

General toxicity of building materials to all populations

The International Living Future Institute Red List contains 814 of the "worst in class" materials prevalent in the building industry.[133] The Red List is put together by architecture firms and organizations that certify buildings to identify chemicals that are particularly harmful to people and the environment.

Census data indicates that in the western United States, 72 percent of new multifamily housing construction was in units of 2,000 square feet or less.[134] In residences with smaller square footage concentrations of toxins in indoor air may increase. This is significant for Portland as our population grows, new multifamily units become more common, and the impacts of construction materials off-gassing are often highest in new housing.

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[131] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[132] Hughes, HK, et al. "Pediatric Asthma Health Disparities: Race, Hardship, Housing, and Asthma in a National Survey." Academic Pediatric Association, Mar. 2017, www.ncbi.nlm.nih.gov/pubmed/27876585.

[133] "The Red List." *International Living Future Institute*, 15 Nov. 2018, http://living-future.org/declare/declare-about/red-list/.

[134] "Characteristics of New Multifamily Units Completed." U.S. Census Bureau, 2018, www.census.gov/construction/chars/pdf/mfu_squarefeet.pdf.

In building materials and design, chemicals of highest concern to indoor air quality include:

- Asthmagens from numerous sources (expanded list in Prenatal and early childhood exposure to indoor asthmagens below)
- PCBs from legacy uses in caulking of windows and ventilation systems
- Nitrogen dioxide from natural gas-burning appliances

Prenatal and early childhood exposure to indoor asthmagens[135]

Building occupants can be exposed to asthmagens in building materials via several pathways:

- the surface of a building finish (carpet, furniture, wall, etc.) may release chemicals from product finishes as dust through degradation or abrasion and can be picked up through the skin on contact;
- dust particles that have absorbed chemicals from products can be inhaled, ingested, or come into contact with the skin;
- and compounds which are volatilized and emitted into the air can be inhaled.

Chemicals of highest concern include:

- Acid Anhydrides in varnishes, paints, coatings and floors
- Acrylates from flooring, paints and acrylic finishes
- Bisphenol A Diglycidyl Ether (BADGE) in coatings and flooring
- Formaldehyde emissions from laminates, insulation, wallboard, engineered wood, acrylic-latex adhesives found in cabinetry, doors and countertops
- Volatile organic compounds (VOCs) - indoor exposure to VOCs can be 5-10 times greater than outdoors[136]
- Phthalates are some of the most widely used and abundant semi-volatile organic chemicals (SVOCs) in indoor environments, released throughout the service life of building products such as vinyl flooring, vinyl carpet backing, lacquers, flooring finishes, adhesives, and fluid applied floors

Over 70 percent of the asthmagens identified by the Healthy Building Network in building materials are not presently covered by leading indoor air quality testing standards. For those chemicals that are covered, the testing thresholds are not typically designed to be protective for asthma onset.

Early life exposures that occur before birth (prenatal) and after birth (postnatal) can impair development of lungs and immune systems. One way that childhood exposures may inflict damage is through disruption of hormonal cell signaling that is responsible for lung development and

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[135] Healthy Building Network's (HBN) research on asthmagens in building materials informs this section. When applicable, additional references that corroborate their findings are added. Please refer to Lott, Sarah, and Jim Vallette. "Full Disclosure Required: A Strategy to Prevent Asthma Through Building Product Selection." Healthy Building Network, Dec. 2013, www.healthybuilding.net/uploads/files/full-disclosure-required-a-strategy-to-prevent-asthma-through-building-product-selection.pdf .

[136] Rumchev, K, et al. "Association of Domestic Exposure to Volatile Organic Compounds with Asthma in Young Children." *Thorax*, BMJ Publishing Group Ltd, 1 Sep. 2004, http://thorax.bmj.com/content/59/9/746.

maturation. Chemical agents, such as phthalates and perfluorocarbons, have the potential to bind to receptors in cells that control development.

At birth, only 30 to 50 percent of the alveoli, air sacs in our lungs responsible for oxygen exchange, are present. After birth, rapid growth of these alveoli occurs. Lung volume doubles by 18 months and again by 5 years of age.[137] Prenatal and early postnatal exposures to sensitizing agents found in building materials can retard the development of lung and immune systems, leaving airways stunted and the immune system biased toward producing IgE antibodies that activate inflammatory cells.[138] Maternal exposures to asthmagens can also cause epigenetic changes that have impacts on the child's immune system development and function.[139]

A study of children between 6 months and 3 years old in Australia showed a strong association among indoor home exposure to VOCs and increased risk of asthma. For every 10 unit increase in the concentration of toluene and benzene (mg/m3), the risk of asthma increased by almost two and three times, respectively.[140]

In another study, households with poor housing quality had 50 percent higher odds of an asthma-related emergency department visit in the past year. Black households are more likely to have children with asthma and asthma-related emergency department visits than their white counterparts. Poor housing quality, in particular, is strongly associated with morbidity from asthma.[141]

General population and indoor air pollution

The greatest impacts to human health in buildings are related to indoor air pollution,[142] which the EPA characterized in 1991 as "one of the greatest threats to public health of all environmental problems."[143] Indoor air pollutants from cleaners, personal care products, paints, etc. are so significant that they are increasingly becoming major sources of outdoor air pollution.[144] Indoor air

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[137] Sly, P.D., and P.G. Holt Chacko. "Environmental Factors in Children's Asthma and Respiratory Effects: Reference Module in Earth Systems and Environmental Sciences." *Encyclopedia of Environmental Health*, 2011, www.sciencedirect.com/science/article/pii/B9780124095489094902.

[138] Henderson, J., and J. Warner. "Fetal Origins of Asthma." *Seminars in Fetal Neonatal Medicine*, 17 Apr. 2012, www.sfnmjournal.com/article/S1744-165X(12)00007-8/abstract.

[139] Martino, DJ, and SL. Prescott. "Progress in Understanding the Epigenetic Basis for Immune Development, Immune Function, and the Rising Incidence of Allergic Disease." *Current Allergy and Asthma Reports*. 13 Feb. 2013, www.ncbi.nlm.nih.gov/pubmed/23054626.

[140] Ibid. "Association of Domestic Exposure…" *Thorax*.

[141] Hughes, H K, et al. "Pediatric Asthma Health Disparities: Race, Hardship, Housing, and Asthma in a National Survey." *Current Neurology and Neuroscience Reports.*, U.S. National Library of Medicine, Mar. 2017, www.ncbi.nlm.nih.gov/pubmed/27876585.

[142] "EPA Green Building Basic Information." Environmental Protection Agency, 20 Feb. 2016, http://archive.epa.gov/greenbuilding/web/html/about.html.

[143] Wallace, Lance A. "Comparison of Risks from Outdoor and Indoor Exposure to Toxic Chemicals." *Environmental Health Perspectives*, vol. 95, 1991, p. 7., https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1568414/.

[144] Mooney, Chris. "In a Surprising Study, Scientists Say Everyday Chemicals Now Rival Cars as a Source of Air Pollution." *The Washington Post*, WP Company, 15 Feb. 2018, www.washingtonpost.com/news/energy-environment/wp/2018/02/15/in-a-surprising-study-scientists-say-everyday-chemicals-now-rival-cars-as-a-source-of-air-pollution/?utm_term=.8f3c393d7f5f.

pollution is of particular importance because people in the United States now spend 90 percent of their time in indoor spaces - including homes, offices, schools and hospitals.[145]

Low-income populations and indoor air pollution

Indoor air quality is an important predictor of health, especially for low-income populations, the majority of whom live in multifamily residences. Several issues related to indoor air quality occur more often in multifamily housing. Based on square footage, concentrations of toxins are often higher in multifamily housing. Inadequate ventilation, high temperatures and high humidity levels (associated with high occupancy) can also increase the concentration of indoor air pollutants.[146] Ventilation is often a challenge due to poor performance of mechanical ventilation systems, resistance to opening windows because of outdoor air quality concerns, and/or concern about energy costs related to use of fans, heaters and air conditioners.[147]

Indoor nitrogen dioxide levels in urban low-income apartments were higher than those typically reported in the U.S. The presence of a gas stove, high occupant densities, smaller apartments, and poor ventilation were likely causes of the higher concentrations of nitrogen dioxide in the indoor environment, which present a health risk, especially for asthmatics.[148]

Multifamily buildings pose unique indoor air quality challenges because pollutants may move from unit to unit and residents have limited ability to make changes to the building structure itself.[149]

Allergen reduction may require interventions such as window and carpet replacement. While these measures may carry a high upfront price tag, research has shown both methods to be effective and cost-effective for reducing chemical exposure risk.[150]

Research comparing conventional and green housing found significant decreases in indoor chemical exposures and improved health outcomes among participants who moved into green housing, suggesting that housing interventions have the potential to improve long-term resident health.[151] However, it is important to note that energy saving measures that seal air flow between the inside and outside can reduce indoor air quality. This is because they can trap in carpet dust through reduced draft, and increase the humidity of the space and the presence of "dust, dust mites,

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[145] Peeples, Lynne. "Are Toxic Chemicals In Building Materials Making U.S. Sick?" *The Huffington Post*, 12 Dec. 2013, www.huffingtonpost.com/2013/12/12/building-materials-asthma_n_4427243.html.

[146] "Energy Efficiency and Indoor Air Quality." HUD USER, www.huduser.gov/portal/consumer/path_1.html.

[147] "Evaluating Ventilation in Multifamily Buildings." *Home Energy Magazine*, Aug. 1994, www.homeenergy.org/show/article/nav/ventilation/id/1059.

[148] "Ventilation in Public Housing: Implications for Indoor Nitrogen Dioxide Concentrations." InformeDesign, 2005, www.informedesign.org/Rs_detail/rsId/2498.

[149] "Indoor Air Quality in Multifamily Housing." Environmental Protection Agency, 8 Aug. 2018, www.epa.gov/indoor-air-quality-iaq/indoor-air-quality-multifamily-housing.

[150] Magbool, N, Viveros, J, and M. Ault. "The Impacts of Affordable Housing on Health: A Research Summary." Center for Housing Policy, Apr. 2015, www.nhc.org/wp-content/uploads/2017/03/The-Impacts-of-Affordable-Housing-on-Health-A-Research-Summary.pdf.

[151] Colton, M D, et al. "Indoor Air Quality in Green vs Conventional Multifamily Low-Income Housing." *Environmental Science Technology*, 15 July 2014, www.ncbi.nlm.nih.gov/pubmed/24941256.

molds, VOCs and other indoor air pollutants."[152] To realize the risk reduction potential of green housing, a heat or energy recovery ventilation system may be necessary.

Hispanics and cancer risk from indoor air pollutants

Hispanics appear to be disproportionately affected by certain hazardous air pollutants from indoor sources. A calculation of cumulative cancer risk (CCR) in Hispanic populations was dominated by formaldehyde, p-DCB, acetaldehyde, chloroform and benzene, primarily from indoor residential sources. Formaldehyde was the largest contributor to CCR for 69 percent of Hispanics, due to prevalent indoor sources such as pressed-wood materials.[153]

Children and others in the school environment and PCBs

Approximately 48,000 U.S. schools were constructed between 1950 and 1980 when PCBs were most extensively used as a plasticizer prior to the manufacturing ban in 1978. These materials likely still impact an estimated 12,960 to 25,920 U.S. schools.[154] It can be extrapolated that similar exposure effects are found in apartments, offices and industrial buildings constructed or renovated the same period.

Caulking is also a primary source of PCBs in and around school buildings. PCBs from exterior caulks around windows and mechanical ventilation system air intakes can lead to elevated PCB concentrations in indoor spaces.[155] Evidence indicates that the main non-occupational source of exposure to PCBs in the entire general population is airborne, challenging the long-held view that diet is the main non-occupational exposure pathway. PCBs in the indoor environment may contribute up to 63 percent of the overall PCB exposure in adults and 36 percent in toddlers.

In addition to exposure by inhalation, children are at particular risk of exposure by touching contaminated materials. People occupying these buildings, including students, teachers and staff of schools, residents, or workers in contaminated buildings have been shown to have elevated serum PCB levels.[156] The effects of long-term inhalation of airborne PCBs are still unknown, but the health effects of PCBs conferred via the diet shows associations with malignant disease, ischemic heart disease, type II diabetes, thyroid dysfunction, neurotoxicity and reproductive health.[157]

Populations in work environments and perfluorinated compounds

Concentrations of FTOH (a PFC) in offices were found to be 3 to 5 times higher than those reported in previous studies of household air, "suggesting that offices may represent a unique and important

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[152] Roberts, J W, and P Dickey. "Exposure of Children to Pollutants in House Dust and Indoor Air." *Reviews of Environmental Contamination and Toxicology,* 1995, www.ncbi.nlm.nih.gov/pubmed/7501867.

[153] Hun, D, et al. "Cancer Risk Disparities between Hispanic and Non-Hispanic White Populations: The Role of Exposure to Indoor Air Pollution." *Environmental Health Perspectives*, 4 Aug. 2009, http://ehp.niehs.nih.gov/0900925.

[154] Herrick, Robert F., et al. "Review of PCBs in U.S. Schools: a Brief History, an Estimate of the Number of Impacted Schools, and an Approach for Evaluating Indoor Air Samples." *Environmental Science and Pollution Research*, 5 May 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4635108/.

[155] Kent, Thomas, et al. "Polychlorinated Biphenyls (PCBs) in School Buildings: Sources, Environmental Levels, and Exposures." *National Exposure Research Laboratory*, EPA, Sept. 2012, www.epa.gov/sites/production/files/2015-08/documents/pcb_epa600r12051_final.pdf.

[156] Ibid. Herrick, Robert F., et al. "Review of PCBs in U.S. Schools."

[157] Bräuner, Elvira Vaclavik, et al. "Health Effects of PCBs in Residences and Schools (HESPERUS): PCB – Health Cohort Profile." *Scientific Reports*, 19 Apr. 2016, www.nature.com/articles/srep24571.

exposure environment." The study also found a strong link between concentrations of FTOH in office air and perfluorooctanoic acid (a metabolite of FTOH) in the blood of office workers. Results also suggested that workers in newly renovated office buildings may receive considerably higher doses of PFCs than workers in older buildings.[158]

Construction workers and chemicals of concern

All work environments, from a construction site to an office building, pose some level of risk for toxic injury. More than 32 million workers (more than 20 percent of the entire U.S. workforce) are exposed to hazardous chemical products in the workplace. OSHA estimates there are 650,000 different chemical products present in more than 3 million American workplaces,[159] with hundreds more being introduced annually.[160]

Seven percent of construction injuries are due to exposure to toxic materials, the most deadly of which is often asbestos.[161] In 2014, nearly 2,000 construction workers reported suffering from work-related illnesses affecting their skin or lungs, and 100 of them were poisoned. This is only a portion of the impact. The Bureau of Labor Statistics (BLS) reported in 2008 that "as much as 69 percent of injuries and illnesses may never make it into the survey."[162]

Most workplace exposures to toxic chemicals in building materials occur during installation, where workers are directly handling and inhaling chemicals. This includes many VOCs and other toxins that aerate in the drying and curing processes such as painting, caulking, finishing, sealing, and adhesives.[163] Due to construction schedules, it is likely that interior construction materials that are both toxic to residents and installers may be installed when ventilation systems are not yet operable, further increasing the concentrations of indoor air toxins and thus the exposures to workers.

An increasing proportion of construction workers in the United States are individual workers hired as independent contractors by prime- or sub-contractors. The U.S. Bureau of Labor Statistics (BLS) estimates that 9 percent of the U.S. workforce is self-employed, but in construction as many as 25 percent of workers are self-employed independent contractors.[164] Prime contractors do not have any obligation to subcontractors under health and safety regulations. This private arrangement has been successfully challenged in court, yet it persists and may become more of a problem for the health and safety of workers on the job.

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[158] Fraser, A, et al. "Polyfluorinated Compounds in Serum Linked to Indoor Air in Office Environments." *Environmental Science Technology*, 2012, http://pubs.acs.org/doi/full/10.1021/es2038257.

[159] "Toxic Injury at Work." The Legal Examiner Wiki, http://wiki.legalexaminer.com/help-center/articles/toxic-injury-at-work.aspx.

[160] "Chemical Hazard Communication." U.S. Department of Labor Occupational Safety and Health Administration, 1998, www.osha.gov/Publications/osha3084.html.

[161] "Construction Workers and Asbestos Exposure." Mesothelioma Cancer Alliance, www.mesothelioma.com/asbestos-exposure/occupations/construction-workers.htm.

[162] Craig, Duane. "Construction's Most Common Hazardous Substances." *The Jobsite*, 8 May 2017, http://jobsite.procore.com/construction-s-most-common-hazardous-substances.

[163] Ibid. Lott, Sarah, and Jim Vallette. "Full Disclosure Required."

[164] Weber, April. "Health and Safety Hazards in the Construction Industry." *ILO Encyclopedia of Occupational Health and Safety*, 9 Mar. 2011, www.iloencyclopaedia.org/component/k2/item/518-health-and-safety-hazards-in-the-construction-industry.

Urban populations and outdoor volatile organic compounds

A 2018 study found that the use of volatile chemical products (VCPs)—including pesticides, coatings, cleaning agents, printing inks, adhesives and personal care products—now constitutes half of fossil fuel VOC emissions in industrialized cities in the U.S., and exceeds that from vehicle fuel emissions.[165]

Federal regulatory context

The chemical constituents in building materials are regulated primarily under the Toxic Substances Control Act (TSCA). This federal legislation, first introduced in 1976 and amended in 2016, regulates chemicals and chemical mixtures that may present "unreasonable risks of injury to health or the environment." TSCA grants authority to the Environmental Protection Agency (EPA) to inventory existing industrial chemicals, manage the introduction of new chemicals to the market, require health and environmental testing of substances of concern, and restrict the manufacture, use and disposal of hazardous chemicals. However, critical limitations of the law have led to continued existence of hazardous chemicals in building materials.

Newly manufactured or imported chemicals for non-exempt commercial purposes must be disclosed to the EPA's New Chemicals Program. The EPA may either approve, limit or deny the use of each chemical reported.

The "Chemical Data Reporting Rule" requires that chemical manufacturers or importers maintain records and prepare reports on chemicals and mixtures and adverse reactions for the 85,000 chemical substances on the TSCA Inventory. However, polymers, chemicals imported in products and various impurities and byproducts are exempt. Furthermore, a high production threshold for reporting means many small and specialty manufacturers are exempt from reporting. It could be quite a long time before a newly introduced chemical is added to the chemicals data inventory and produced at a volume that would require reporting.

The Interagency Testing Committee (ITC) reviews existing chemicals and adds up to 50 per year to a priority testing list. Where substances are found to present serious or widespread harm from cancer, gene mutations or birth defects, the EPA is required to take "appropriate regulatory action." However, in the first 40 years of TSCA, prior to 2016, the ITC used its testing rule authority to require testing of just 200 of the 85,000 chemicals in the inventory. Additional studies are conducted by academic centers and private laboratories, but there is no systematic means for collecting the data from these studies, or for ensuring their quality. The continuing absence of this information is particularly problematic because, in practice, the lack of toxicity information for many chemicals is often treated as if it were evidence of their safety.

State action on a chemical is preempted when EPA finds (through a risk evaluation) that the chemical is safe or takes final action to address the chemical's risks. State action on a chemical is temporarily "paused" when EPA's risk evaluation on the chemical is underway, but lifted when EPA completes the risk evaluation or misses the deadline to complete the risk evaluation. States can

[165] "Volatile chemical products emerging as largest petrochemical source of urban organic emissions." *Science*, 16 Feb. 2018, http://science.sciencemag.org/content/359/6377/760.

apply for waivers from both general and "pause" preemption. If certain conditions are met, EPA may grant an exemption from preemption.[166]

Of particular interest to Metro, the 2016 update to TSCA clarifies and preserves states' ability to act on any chemical, or particular uses or risks from a chemical, which EPA has not yet addressed (which are vast). It also allows states and the federal government to co-enforce identical regulations. Also, given the EPA's very minimal expectations – 20 chemical evaluations every 3.5 years – the update creates a wide field of opportunity for action by states.

For more information on TSCA, please review the *Regulatory context of chemicals in the United States* section.

Western U.S. regulatory context and local action

Oregon

Green Building Program

In 2010, the Department of Environmental Quality (DEQ) released a report reviewing construction practices and recommendations to create policy for a reduction in materials waste.[167] Two of the major conclusions was that reducing the size of homes and building multi-family buildings would likely lead to the greatest reduction in waste and in environmental, health and climate impacts. Under DEQ's green building program website, they provide resources for building Accessory Dwelling Units as a way to reduce waste and impacts.[168]

Deconstruction and demolition legislation

With Portland's modern population growth, the construction of new homes and buildings has also risen. In many cases, this requires the demolition of properties to make way for new construction. However, mechanical demolition of properties built before 1978 (when lead paint was regularly used for exterior and interior paint) can pose a health risk because of the contaminants in building materials that are dislodged into air and soil during demolition.

In 2016, Portland City Council passed one of the first deconstruction ordinances in the country. The ordinance aims to ensure safer deconstruction of buildings built in 1916 or earlier or designated historic resources to reduce exposure to lead dust and to salvage valuable materials for reuse. This ordinance led to the deconstruction of approximately 180 single-family homes in Portland during its first two years.[169] The required practices reduce the amount of waste generated, limit carbon emissions and reduce exposure to harmful lead and asbestos dust.

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[166] Ibid. "Highlights of Key Provisions in the Frank R. Lautenberg Chemical Safety for the 21st Century Act." Environmental Protection Agency.

[167] "A Life Cycle Approach to Prioritizing Methods of Preventing Waste from the Residential Construction Sector in the State of Oregon." Department of Environmental Quality, 29 Sep. 2010, www.oregon.gov/deq/FilterDocs/ADU-ResBldgLCA-Report.pdf.

[168] "DEQ Green Building Program." Department of Environmental Quality, www.oregon.gov/deq/mm/Pages/Green-Building.aspx.

[169] "Deconstruction Requirements." City of Portland Bureau of Planning and Sustainability, 6 July 2016, www.portlandoregon.gov/bps/70643.

In 2017, the Oregon Senate passed SB 871 that enables city governments to manage lead and asbestos hazards associated with the demolition of homes.[170] This bill was also supported by the Multnomah County Health Department because, as their Environmental Health Director, Jae Douglas stated in her testimony advocating for this bill, "it provides a measure of protection for public health where none currently exists."[171]

On February 1, 2018, Tony Green, the Deputy Ombudsman with the Portland City Auditor's Office explained before City Council why Portland's 2016 deconstruction ordinance did not include properties built after 1916.[172] He noted the initial goal was to not overwhelm the fledgling deconstruction market. However, this left out many homes built before 1978 when the use of lead paint halted. In 2018 the Portland City Council passed the Asbestos and Lead-Based Paint Mitigation in Residential Demolitions (an SB 871 Implementation Ordinance) to close that regulatory gap.

California

Proposition 65

In 1986, California Proposition 65[173] was a voter-approved initiative that eventually led to the Safe Drinking Water and Toxic Enforcement Act of 1986, requiring the state to publish a list of chemicals known to cause cancer on certain products.[174] Proposition 65 is a consumer "right to know" law. The law includes a requirement to include warning labels on construction materials that contain harmful chemicals that, when disturbed during construction or renovation, can cause serious health problems.[175]

CALGreen Code

CALGreen Code is short for California's Green Building Standards Code[176], which was first established through official building codes in the state in 2011 and has been updated regularly as with all building codes. It is the first state-mandated green building code in the country requiring all new construction or significant renovations to follow certain green standards to improve overall public health and environmental impact while encouraging sustainable construction practices.[177] CALGreen regulates the planning and design, environmental quality, water efficiency and conservation, and material conservation and resource efficiency. There are "tiered" options above the base standards in which building companies can voluntarily participate.[178]

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[170] Schick, Tony. "Oregon Lawmakers Look To Close Demolition Loophole For Lead Dust." *Oregon Public Broadcasting*, 9 Apr. 2017, www.opb.org/news/article/oregon-lawmakers-look-to-close-demolition-loophole-for-lead-dust/.

[171] "Re: SB 871- Lead-Based Paint in Demolitions." Senate Committee on Environment and Natural Resources, 6 Apr. 2017, www.olis.leg.state.or.us/liz/2017R1/Downloads/CommitteeMeetingDocument/117249.

[172] "Containing toxic dust during demolitions." City of Portland Deputy Ombudsman Remarks, 1 Feb. 2018, www.portlandoregon.gov/ombudsman/article/672186.

[173] "Proposition 65 Plain Language." OEHHA, 1 Feb. 2013, http://oehha.ca.gov/proposition-65/general-info/proposition-65-plain-language.

[174] "Chemicals Considered or Listed Under Proposition 65." OEHHA, http://oehha.ca.gov/proposition-65/chemicals.

[175] "Prop 65 Guide for Residents." California Apartment Association, http://caanet.org/prop65apt/.

[176] "2016 California Green Building Standards Code." California Building Standards Commission, 2016, https://www.ladbs.org/docs/default-source/publications/code-amendments/2016-calgreen_complete.pdf?sfvrsn=6.

[177] "CALGreen Compliance." California Department of Housing and Community Development, July 2016, www.hcd.ca.gov/building-standards/calgreen/index.shtml.

[178] "Green Building." *Building in California*, www.buildingincalifornia.com/green-building/.

Safer Consumer Products (SCP) Program

California launched the Safer Consumer Products (SCP) Program[179] in 2013, a green chemistry initiative with a goal to reduce the toxic chemical exposure from everyday product use and to participate in promoting the development and technology around greener products. The process the program takes includes the following:[180]

1. SCP identifies which chemicals pose health or environmental hazards.
2. SCP identifies the products that contain the chemicals. These are called "Priority Products."[181]
3. The companies that make Priority Products will evaluate their use of hazardous chemicals in their products by using the Alternative Analysis process, which involves examining safer alternatives to chemicals of concern.[182]
4. SCP issues a regulatory response.
5. Companies make adjustments to the products based on the regulatory response requirements.[183]

Regulatory context and action in other regions of the U.S.

Low-Income Housing Tax Credit Program: affordable green housing

The American Planning Association released a report in 2013 describing a new trend in green lower-income housing projects.[184] The ability to make green building mainstream and accessible for affordable housing developments came out of the Low Income Housing Tax Credit Program (LIHTC, Section 42 of the IRS Code). Because these tax credit programs are highly competitive, there was recognition that LIHTC standards had a lot of influence over affordable housing practices.

Green building standards and history in the U.S.

According to an EPA archive of green building standards and history in the U.S., the contemporary movement in green building emerged around the 1970s when oil prices increased.[185] The field began to formalize in the 1990s. During that time the American Institute of Architects (AIA) formed the Committee on the Environment,[186] the EPA and the U.S. Department of Energy launched the ENERGY STAR program,[187] and the U.S. Green Building Council (USGBC) was founded.[188]

The federal government's major initiatives around green building achieved many milestones in the mid-2000s, such as with the Energy Policy Act of 2005,[189] an unveiling of an Environmental

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[179] Ibid. "Safer Consumer Products Program." California Department of Toxic Substances Control.
[180] Ibid. Singla, Veena. "New California program is on a Mission to Reduce Toxic Chemicals in our Everyday Products."
[181] Ibid. "What is a Priority Product?" California Department of Toxic Substances Control.
[182] Ibid. Singla, Veena. "Selecting Safer Alternatives To Toxic Chemicals..." *NRDC*, June 2017.
[183] Ibid. "Final 2018-2020 Priority Product Work Plan." California Department of Toxic Substances Control.
[184] "Green Goes Mainstream in Low-Income Housing." American Planning Association, 2013, http://mrsc.org/getmedia/5C1945EA-F7D2-4AF1-9A97-3E221D65F0D7/Fuhry.aspx.
[185] "Definition of Green Building." Environmental Protection Agency, 20 Feb. 2016, http://archive.epa.gov/greenbuilding/web/html/about.html.
[186] "Committee on the Environment." AIA, http://network.aia.org/committeeontheenvironment/home.
[187] "Energy Star Program." Energy Star, www.energystar.gov/.
[188] USGBC Homepage." USGBC, http://new.usgbc.org/.
[189] "Energy Policy Act of 2005." U.S. Government GPO, 8 Aug. 2005, www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf.

Scorecard by the Office of Management and Budget which includes a Sustainable Building element,[190] the publishing of the Federal Green Construction Guide for Specifiers,[191] and the Energy Independence and Security Act of 2007,[192] which required high performance green federal buildings.

The EPA formed a Green Building Workgroup in July 2003 to bring together cross-agency programs with building and development sectors to improve environmental performance. Additionally, the EPA adopted a new Green Building Strategy in 2008.[193,194]

Some resources that are currently available on EPA's website include a Sustainable Design and Green Building Toolkit for Local Governments[195] and a description of EPA's green buildings.[196]

[190] "Office of Management and Budget Scorecards on Sustainability and Energy." Environmental Protection Agency, 2017, www.epa.gov/greeningepa/office-management-and-budget-scorecards-sustainability-and-energy.
[191] "Federal Green Construction Guide for Specifiers." National Institute of Building Sciences, www.wbdg.org/ffc/epa/federal-green-construction-guide-specifiers.
[192] "Summary of the Energy Independence and Security Act." Environmental Protection Agency, 19 Dec. 2007, www.epa.gov/laws-regulations/summary-energy-independence-and-security-act.
[193] "EPA Green Building Strategy (archived)." Environmental Protection Agency, Nov. 2008, http://archive.epa.gov/greenbuilding/web/pdf/greenbuilding_strategy_nov08.pdf.
[194] "Green Building (archived)." EPA, http://archive.epa.gov/greenbuilding/web/html/.
[195] "Sustainable Design and Green Building Toolkit for Local Governments." Environmental Protection Agency, https://www.epa.gov/smartgrowth/sustainable-design-and-green-building-toolkit-local-governments.
[196] "Green Buildings at EPA." Environmental Protection Agency, www.epa.gov/greeningepa/green-buildings-epa.

Community health risk and regulatory context of chemicals in

Carpet

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: Carpets and rugs cover nearly half of all U.S. homes and workplaces. The Healthy Building Network identified 44 hazardous substances in carpet that impact human health and complicate recycling and waste management. Chemicals that may be found in carpet include carcinogens, endocrine disruptors, thyroid disruptors, some are linked to dysfunction in reproductive and neurological systems, while others are linked to impacts on fetal and child development. While the industry is making changes to respond to consumer demands for safer products, much needs to be done to remove chemicals in carpet that may contribute to unsafe indoor environments and pose potential hazards when recycling carpet components. Infants and children can be exposed from inhalation or ingestion of dust. Pregnant and lactating women can transfer chemicals that may be found in carpet through their blood and breastmilk. Workers in carpet installation and foam recycling are also at higher risk of negative health outcomes from toxics in carpet and carpet foam.

Regulatory context: The chemical constituents in carpet are federally regulated largely under the Toxic Substances Control Act. In 2013 the EPA issued a rule requiring companies to report all new uses of certain PFOA-related chemicals used in carpet manufacture or treatment. Carpet America Recovery Effort, an industry initiative, has promoted voluntary product stewardship programs to increase carpet recycling. Several states have proposed Extended Producer Responsibility laws but only California has passed legislation. Oregon Department of Environmental Quality has identified carpet as a "high impact" material whose recovery should be increased.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals)

and non-chemical stressors (such as from racism or socioeconomic status).[197] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Population at large and general toxicity of carpets

People are exposed to toxics from carpet, padding, and accumulated household dust in old carpet primarily in their homes and workplaces. Carpets may contain stain-resistant per- and polyfluorinated chemicals (PFAS, also known as PFCs). Carpets may also contain the flame retardant polybrominated diphenyl ethers (PBDEs), which is used in carpeting, textiles, electronics and plastics. Routine wear and tear, and any type of cleaning, can dislodge PFAS and PBDE chemicals from carpet fibers into air, which can then resettle as dust on surfaces, floors and carpets.

Human toxicology studies have revealed that PFOS and PFOA (two different kinds of PFAS) are readily absorbed via oral exposure and that they accumulate primarily in the serum, kidney and liver.[198] Once in the body PFOS and PFOA have a half-life ranging from 2 to 9 years, which means that they persist in humans for a significant amount of time.[199]

Antimicrobial chemicals are used as preservatives in carpet fibers and backing. These biocides target microorganisms (e.g., bacteria and mold) that consume and inhabit carbon-based ingredients like phthalates, polyurethanes, latex and polyesters. The most commonly used antimicrobials include: zinc pyrithione, a systemic toxicant that can trigger asthma or other allergic reactions; triclosan, a halogenated phenolic compound and a known endocrine disruptor; and formaldehyde, a known carcinogen in high levels.[200]

Hazardous flame retardants in carpet fibers, post-consumer recycled foam and new bonded carpet padding present a concern for occupant exposure and throughout the product's life cycle. When flame retardants migrate out of carpets, they can become part of household dust that building occupants then inhale or ingest. The National Institute of Environmental Health Sciences warns that "a growing body of evidence shows that many of these chemicals are associated with adverse health effects in animals and humans, including endocrine and thyroid disruption, impacts to the immune system, reproductive toxicity, cancer, and adverse effects on fetal and child development and neurologic function."[201] An EPA report explains that "as carpet padding ages, foam dust will be generated and become airborne with traffic on carpet. This presents an important exposure pathway for children, who spend time on the floor."[202]

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[197] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[198] "Federal Register Vol. 71 No. 47." Environmental Protection Agency, 10 Mar. 2006, www.gpo.gov/fdsys/pkg/FR-2006-03-10/pdf/E6-3444.pdf.

[199] Ibid. "Emerging Contaminants Fact Sheet—PFOS and PFOA." Environmental Protection Agency.

[200] Vallette, James. "Eliminating Toxins in Carpet: Lessons for the Future of Recycling." *Healthy Building Network*, Oct. 2017. http://healthybuilding.net/uploads/files/eliminating-toxics-in-carpet-lessons-for-the-future-of-recycling.pdf.

[201] "Flame Retardants." National Institutes of Environmental Health Sciences, July 2016, https://www.niehs.nih.gov/health/materials/flame_retardants_508.pdf.

[202] "Furniture Flame Retardancy Partnership: Environmental Profiles of Chemical Flame-Retardant Alternatives for Low-Density Polyurethane Foam." Environmental Protection Agency, Sep. 2005, www.epa.gov/sites/production/files/2015-04/documents/ffr_foam_alternatives_vol1.pdf.

Pregnant women, prenatal development and PBDEs and PFAS

PBDEs and PFASs can migrate from the mother to the developing and vulnerable fetus through transplacental migration. Prenatal exposure to PBDEs may disrupt thyroid function and contribute to adverse neurodevelopmental outcomes.[203] Negative health outcomes extend to women seeking to conceive. Transfer to the fetus is one of the major PFAS elimination routes for women, particularly for PFOA. Breastfed infants are susceptible to increased exposures to PFASs in breast milk, because breastfeeding is a route of PFAS excretion for lactating women.[204] PBDE exposure has also been associated with reduced fecundability for women.[205]

Children and PBDE and PFAS exposure

The U.S. Centers for Disease Control named carpet as the number one exposure pathway to PFASs for infants and toddlers who spend a lot of time lying, playing and crawling on carpeting.[206] Infants, toddlers and small children are particularly sensitive because of their increased ingestion and inhalation rates per unit of body weight, rapid development, immature physiological ability to detoxify environmental contaminants, and behavioral characteristics that predispose them to increased exposures to environmental contaminants.[207] A systematic review of developmental exposures to PBDE suggests there is sufficient evidence supporting an association between developmental PBDE exposure and reduced IQ. Preventing child exposure to PBDEs could help reduce negative health outcomes such as reduction in IQ.[208]

Children and toxics exposure via dust

The accumulation of toxics in dust - lead, pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and volatile organic compounds (VOCs) - may be the most significant exposure pathway for children. Children exposed to carpet dust in Columbus and Seattle homes contained concentrations of several toxics at levels harmful enough to be associated with lead poisoning, cancer, allergies, asthma, nervous system damage and sick building syndrome.[209]

Foam recyclers and carpet installers and PBDEs

Individuals working in foam recycling facilities and carpet installers have body burdens of PDBEs that are an order of magnitude higher than the standard population.[210]

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[203] Zota, Ami et al. "Polybrominated Diphenyl Ethers, Hydroxylated Polybrominated Diphenyl Ethers, and Measures of Thyroid Function in Second Trimester Pregnant Women in California." *Environmental Science and Technology*, 10 Aug. 2011, http://pubs.acs.org/doi/full/10.1021/es200422b.

[204] "Product – Chemical Profile for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs) in Carpets and Rugs." Department of Toxic Substances and Control, Feb.2018, http://dtsc.ca.gov/SCP/upload/Product-Chemical-Profile-PFAS-Carpets-and-Rugs.pdf.

[205] Harley, Kim, et al. "PBDE Concentrations in Women's Serum and Fecundability." *Environmental Health Perspectives*, May 2010, http://ehp.niehs.nih.gov/wp-content/uploads/118/5/ehp.0901450.pdf.

[206] Ibid. "An Overview of Perfluoroalkyl and Polyfluoroalkyl Substances and Interim Guidance ..." Centers for Disease Control.

[207] "Exposure Factors Handbook." Environmental Protection Agency, 2011, http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252.

[208] Lam, Juleen, et al. "Developmental PBDE Exposure and IQ/ADHD in Childhood: A Systematic Review and Meta-analysis." *Environmental Health Perspectives*, Aug. 2017, www.ncbi.nlm.nih.gov/pubmed/28799918.

[209] Ibid. Roberts, J W, and P Dickey. "Exposure of Children to Pollutants in House Dust and Indoor Air."

[210] "Serum levels of polybrominated diphenyl ethers (PBDEs) in foam recyclers and carpet installers working in the United States." Environmental Science and Technology, May 2008, https://www.ncbi.nlm.nih.gov/pubmed/18522133.

Office workers and the perfluorinated compound FTOH

Concentrations of FTOH (a PFAS) in offices were discovered to be 3 to 5 times higher than concentrations reported in studies of household air, "suggesting that offices may represent a unique and important exposure environment." The study also found a strong link between concentrations of FTOH in office air and perfluorooctanoic acid (a metabolite of FTOH) in the blood of office workers. Results from this particular study also suggested that workers in newly renovated office buildings may receive considerably higher doses of PFCs than workers in older buildings.[211,212]

Federal regulatory context

Toxic Substances Control Act

The chemical constituents in carpet are regulated under the Toxic Substances Control Act (TSCA). This federal legislation, first introduced in 1976, regulates chemicals and chemical mixtures that may present "unreasonable risks of injury to health or the environment." TSCA grants authority to the Environmental Protection Agency (EPA) to inventory existing industrial chemicals, to manage the introduction of new chemicals to the market, to require health and environmental testing of substances of concern, and to restrict the manufacture, use and disposal of hazardous chemicals or products containing them.

State action through TSCA on a chemical is preempted when EPA finds (through a risk evaluation) that the chemical is safe or takes final action to address the chemical's risks. State action on a chemical is temporarily paused when EPA's risk evaluation on the chemical is underway, but lifted when EPA completes the risk evaluation or misses the deadline to complete the risk evaluation. States can apply for waivers from both general and pause preemption.[213]

In 2013 the EPA issued a rule requiring companies to report all new uses of certain PFOA-related chemicals as part of carpets.[214] Companies must now report to EPA their intent to manufacture these chemical substances intended for use as part of carpets, treatment of carpet, including importing the chemicals or carpets already containing these chemical substances.

State and local carpet management and regulation

Carpet is a bulky and difficult to manage product that has a significant presence, by weight, in the waste stream. It is also recognized as a high impact material as its production involves the substantial generation of greenhouse gases (GHGs). Efforts to divert the product from landfills and increase the amount recycled have been proven very difficult over the past several decades.

In the early 2000s, carpet manufacturers, recyclers, government agencies and other stakeholders initiated efforts to advance carpet recycling. A voluntary memorandum of understanding was

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[211] Fraser, Alicia J, et al. "Polyfluorinated Compounds in Serum Linked to Indoor Air in Office Environments." *Environmental Science and Technology*, 8 Dec. 2011, http://pubs.acs.org/doi/full/10.1021/es2038257.

[212] Fraser, Alicia J, et al. "Polyfluorinated Compounds in Dust From Homes, Offices, and Vehicles as Predictors of Concentrations in Office Workers' Serum." *Environment International* Vol. 60 128-36, 2013, https://www.ncbi.nlm.nih.gov/pubmed/24041736.

[213] Ibid. "Highlights of Key Provisions in the Frank R. Lautenberg Chemical Safety for the 21st Century Act." Environmental Protection Agency.

[214] "Perfluoroalkyl Sulfonates and Long-Chain Perfluoroalkyl Carboxylate Chemical Substances; Final Significant New Use Rule." Federal Register, 22 Oct. 2013, www.federalregister.gov/documents/2013/10/22/2013-24651/perfluoroalkyl-sulfonates-and-long-chain-perfluoroalkyl-carboxylate-chemical-substances-final.

signed in 2002 among these parties establishing landfill diversion (40 percent) and recycling (20 to 25 percent) rate goals for carpet over the next ten years. An industry organization, Carpet America Recovery Effort (CARE) was established to help achieve these goals. However, by 2010 the national carpet recycling rate was only at 4.5 percent. A second round of negotiations failed to produce a new path forward and efforts to advance carpet recycling began to focus more on legislation.

California

In 2010, California became the first state to pass extended producer responsibility (EPR) legislation for carpet. The legislation was lacking in important EPR elements and was revised in 2017.[215] The 2017 amendment included:

1. Setting a goal of 24 percent recycling by 2020.
2. Requiring an increase in collection convenience.
3. Expanding markets for products made from post-consumer carpet.
4. Examining stain-resistant chemicals (PFAS) in carpets and rugs.

Subsequently, California has proposed that stain-resistant chemicals (PFAS) found in rugs be added to the priority product list under the Safer Consumer Products (SCP) Program.[216] This move was made because the California Department of Toxic Substances Control identified rugs as a significant source of widespread PFAS exposures.[217]

Other states

Other states including Minnesota, New York, Washington and Illinois have seen carpet EPR legislation proposed. Oregon has identified carpet as one of three "high impact" materials[218] (along with plastics and food waste) whose recycling should be increase, but has not yet seen carpet EPR legislation proposed.

San Francisco

In March 2018, The City of San Francisco adopted sustainable carpet purchasing requirements.[219,220,221] The specifications include the following:

- Carpet tile only - no broadloom (rolled) carpet except for specific situations

[215] "Carpet." Product Stewardship Institute, 24 Dec. 2018, https://www.productstewardship.us/page/Carpet.
[216] "Stewardship Program Overview." CalRecycle Carpet Stewardship Program, 18 Aug. 2018, www.calrecycle.ca.gov/carpet/program.htm.
[217] "In a First, California Moves to Protect People from Toxic PFAS Chemicals in Carpets." Environmental Working Group, 13 Mar. 2018, www.ewg.org/news-and-analysis/2018/03/first-california-moves-protect-people-toxic-pfas-chemicals-carpets-0#.WuIowq3MzeR.
[218] Ibid. "Administrative Order No. DEQ 3-2017." Oregon Bulletin.
[219] "Adopting Approved Alternative Products for Sustainable Carpet for City Departments: #SFE 207 8-01-PPO/GBRCBO." San Francisco Department of the Environment Regulation, 9 Mar. 2018, www.sfenvironment.org/sites/default/files/policy/regulation_sfe-2018-01-ppo_gbrcbo.pdf.
[220] "Home Page." *SFApproved*, www.sfapproved.org.
[221] "Shaw/Patcraft Carpet Tiles." Shaw/Patcraft, 9 Mar. 2018, www.docs.google.com/spreadsheets/d/1B7bU4Me3dPrtcnhsPPrFsW0WwU-C8nl3kt3IhhLrvfo/edit#gid=0.

- Cradle to Cradle Silver certification (includes prohibition on many, not all, chemicals of concern)
- No poly- or perfluorinated compounds
- 45 percent recycled content, 10 percent postconsumer minimum
- No flame retardants
- No antimicrobials
- Strict VOC limitations
- Transparency requirements for Environmental Product Declarations and Health Product Declarations
- No PVC
- No coal fly ash
- No polyurethane
- No styrene butadiene latex
- Requirements for fiber type and dying (to make stain-resistant treatments less important)

The San Francisco Housing Authority and the San Francisco Department of Public Health conducted a Health Impact Assessment (HIA) in 2015 analyzing decisions about flooring materials that showed the impact that local authorities can have by their unique ability to engage directly with housing stakeholders (i.e. advocates, property owners, housing authority staff, agency officials and tenants). Because they worked with local stakeholders on the assessment, the HIA recommendations were generally aligned with stakeholder input. The HIA recommended that a portion of new low-income housing units be built without carpeting because of the effect of carpet on exacerbating asthma and allergies.[222]

[222] "Health Impact Assessment and Housing." Health Impact Project, Mar. 2016, www.pewtrusts.org/~/media/assets/2016/03/guidance_for_the_public_health_sector.pdf.

Community health risk and regulatory context of chemicals in

Children's products

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: Products made for children and adolescents may contain a variety of chemicals of concern. Children's personal care products, all products made for infants and mouthable toys are of particular concern. This review primarily covers exposure to phthalates, bisphenols, PVC, lead and cadmium. Product tests have found a high percentage of children's products contained lead. Cadmium has been used as a replacement for lead in some products, but poses its own health risks. Although legislation and industry pressure has likely resulted in decreased presence of some types of phthalates and BPA, they are often replaced with other similar compounds that raise a similar level of concern. Prenatal exposure to phthalates can impact cognitive development and are linked to male reproductive abnormalities. Infants are disproportionately impacted by toxics in products through their propensity to put items in their mouths, their small size and developing body systems.

Regulatory context: At the federal level, chemical constituents in children's products are primarily regulated under the Consumer Product Safety Act. State governments also regulate chemicals in children's products. Washington's Children's Safe Products Act limits lead, cadmium, and several phthalates in children's products sold in Washington. The state has also banned BPA from children's food and beverage containers and reusable water bottles, as well as children's products and residential furniture containing the flame retardants TDCPP and TCEP. California's Safer Consumer Products Program aims to reduce toxic chemical exposure from everyday product use, including from children's products. California banned the manufacture, sale, and distribution of any toy or child care product that contains more than 0.1 percent of three types of phthalates, cadmium in children's jewelry, and any children's jewelry not made of approved compounds. Oregon's Toxic-Free Kids Act requires manufacturers to report products containing high priority chemicals of concern for children's health and authorizes the state to ban the sale of some of these products, if a waiver is not granted. Vermont and Maine are other states where there is strong legislation around toxic chemicals in children's products.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other

historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals) and non-chemical stressors (such as from racism or socioeconomic status).[223] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Use of the terms "children," "infants" and "adolescents" in this Study will not always refer to the same age ranges since various sources and statutes use different definitions. Despite the title of this section "Children's products" the studies cited here do include research on a broader range of ages from pre-natal through adolescence. What is more, emerging research suggests that brain development continues into the 30s,[224] expanding even further the age range during which developmental impacts from chemicals may occur.

Infants/children and phthalate exposure

Phthalates are a class of chemicals originally used to make plastics flexible.[225] In a study that looked at nine types of phthalates commonly found in infant products, such as lotions, powders and shampoos, seven were above the limit of detection in 81 percent of the infants (n=163). Urine samples were collected within 24 hours of the product being used and the concentration as well as the number of types of phthalates detected increased with the number of products used. The younger the infant, the stronger the association due to their still developing metabolic system and their small surface area (i.e., small bodies in proportion to their exposure).[226]

Infant exposure to toxics via mouthable products made of polyvinyl chloride (PVC)-based materials is also a significant exposure pathway to phthalates. Because phthalates are not chemically bound to PVC, phthalates in PVC products can enter infants' saliva through chewing.[227] For example, infant pacifiers can result in oral exposure to phthalates.[228] A 1998 Consumer Product Safety Commission (CPSC) study of children's plastic teethers and toys discovered that DINP (a type of phthalate) was present in 31 of the 35 items tested,[229] prompting the voluntary removal of DINP by manufacturers in products "intended to be mouthed." However, the use of DINP in soft plastic toys persists.

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[223] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[224] Committee on Improving the Health, Safety, and Well-Being of Young Adults; Board on Children, Youth, and Families; Institute of Medicine; National Research Council; Bonnie RJ, Stroud C, Breiner H, editors. *Investing in the Health and Well-Being of Young Adults.* Washington DC, National Academies Press, 27 Jan. 2015, Chapter 2, Young Adults in the 21st Century, https://www.ncbi.nlm.nih.gov/books/NBK284782/.

[225] "Biomonitoring: Phthalates." Environmental Protection Agency, www.epa.gov/sites/production/files/2015-05/documents/biomonitoring-phthalates.pdf.

[226] Sathyanarayana, S, et al. "Baby Care Products: Possible Sources of Infant Phthalate Exposure." *AAP News and Journal Gateway,* Feb. 2008, www.ncbi.nlm.nih.gov/pubmed/18245401.

[227] Gurusankar, Saravanabhavan and Janine Murray. "Human Biological Monitoring of Diisononyl Phthalate and Diisodecyl Phthalate: A Review." *Journal of Environmental and Public Health*, 17 Oct. 2011, www.hindawi.com/journals/jeph/2012/810501/.

[228] "Updated Risk Assessment of Oral Exposure to Diisononyl Phthalate (DINP) in Children's Products." U.S. Consumer Product Safety Commission, Aug. 2002, www.researchgate.net/publication/292146526_Updated_Risk_Assessment_of_Oral_Exposure_to_Diisononyl_Phthalate_DINP_in_Children's_Products.

[229] Ibid. "Updated Risk Assessment of Oral Exposure to DINP." U.S. Consumer Product Safety Commission.

Exposure to DINP through the skin has also been observed, in apparel items made of PVC such as rainwear and sandals, as well as through plastic crib and bed liners.[230]

Adolescent girls are also particularly vulnerable to phthalate exposure due to their heavy usage of personal care products. For example, a study in California found that all of the study participants (n=100 Latina girls) experienced significant decreases in urinary phthalates, parabens and triclosan after they changed the use of personal care products to those that had labels specifically stating they lacked those chemicals.[231] Phthalate exposure may have irreversible developmental impacts. For instance, a study of Danish children aged 4 to 9 showed a correlation between higher concentrations of urinary phthalate concentration and shorter height for both girls and boys.[232]

Pregnant women, fetuses and phthalates

Even though phthalates pass through the body relatively quickly,[233] their ubiquity in products presents a health risk. For example a positive presence for phthalates was detected in 85 to 100 percent of a test group of 246 pregnant Dominican and African-American women.[234] Once exposed, placental transfer of these chemicals can occur through the blood to a developing fetus.[235] Although legislation and industry pressure over the past decade has likely resulted in decreased presence of some DEHP - one type of phthalate - they are often replaced with other types - DiNP and DiDP - that have a similar level of concern.[236,237]

In a study examining the effects of prenatal phthalate exposure on cognitive development, three-year olds with elevated phthalate exposure were more likely to develop motor delays, certain behavior problems and decreased mental development.[238] Prenatal phthalate exposure has also been linked to male reproductive abnormalities, including smaller genitals and incomplete descent of the testicles.[239]

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[230] Ibid. "Updated Risk Assessment of Oral Exposure to DINP." U.S. Consumer Product Safety Commission.
[231] Harley, KG, et al. "Reducing Phthalate, Paraben, and Phenol Exposure from Personal Care Products in Adolescent Girls: Findings from the HERMOSA Intervention Study." *Environmental Health Perspectives*, 7 Mar. 2016, http://ehp.niehs.nih.gov/15-10514/.
[232] Boas, M, et al. "Childhood Exposure to Phthalates: Associations with Thyroid Function, Insulin-like Growth Factor I, and Growth." *Environmental Health Perspectives,* 9 July 2010, http://ehp.niehs.nih.gov/0901331/.
[233] Genuis, Stephen, et al. "Human Elimination of Phthalate Compounds: Blood, Urine, and Sweat (BUS)." *The Scientific World Journal*, 31 Oct. 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC3504417/.
[234] Adibi, JJ, et al. "Characterization of Phthalate Exposure among Pregnant Women Assessed by Repeat Air and Urine Samples." *Environmental Health Perspectives,* Apr. 2008, www.ncbi.nlm.nih.gov/pmc/articles/PMC2291011/.
[235] Mose, T. et al. "Phthalate Monoesters in Perfusate from a Dual Placenta Perfusion System, the Placenta Tissue and Umbilical Cord Blood." *Reproductive Toxicology,* Jan. 2007, www.sciencedirect.com/science/article/pii/S0890623806002048?via%3Dihub.
[236] Zota, AR, Calafat AM, and TJ Woodruff. "Temporal Trends in Phthalate Exposures: Findings from the National Health and Nutrition Examination Survey." *Environmental Health Perspectives*, 15 Jan. 2014, http://ehp.niehs.nih.gov/1306681/.
[237] "Evaluation of New Scientific Evidence Concerning DINP and DIDP." European Chemicals Agency, 2013, http://echa.europa.eu/documents/10162/31b4067e-de40-4044-93e8-9c9ff1960715.
[238] Whyatt, RM, et al. "Maternal Prenatal Urinary Phthalate Metabolite Concentrations and Child Mental, Psychomotor, and Behavioral Development at 3 Years of Age." *Environmental Health Perspectives*, 6 Sep. 2011, http://ehp.niehs.nih.gov/1103705/
[239] Kim, Y, et al. "Prenatal Exposure to Phthalates and Infant Development at 6 Months: Prospective Mothers and Children's Environmental Health (MOCEH) Study." *Environmental Health Perspectives,* 1 Oct. 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC3230435/.

Infants/children and bisphenols BPA, BPS and others

BPA was used in baby bottles until 2012, when its use was banned by the FDA. Infants continue to display measurable levels of exposure to BPA. A recent study of 59 baby teethers, many of which were labeled "BPA-free" or "non-toxic," found that the teethers leached BPA, parabens and antimicrobials when soaked in water for an hour.[240]

While the impacts of exposure to BPA and bis(2-ethylhexyl) phthalate (DHEP) have been well-studied, the impacts of many other phthalates and bisphenols have not. It appears that exposure to BPS and a myriad of other phthalates are associated with oxidative stress, insulin resistance, albuminuria and vascular disturbance in children. While exposure to BPA is often from food, they can also be absorbed dermally[241].

Following the ban on BPA, bisphenol S (BPS) and bisphenol F (BPF) were introduced as a chemical replacement in many plastic products.[242] BPS has been detected in everyday products such as personal care products, paper products, food, and indoor dust, and in urine samples.[243] Thermal receipt paper is also a source of occupational exposure to BPS[244] (see *Workplace exposures in the service sector*). However, "based on the current literature, BPS and BPF are equally hormonally active as BPA, and they also have endocrine-disrupting effects. For example, "BPF was found to have potencies in the same order of magnitude as BPA in regard to androgenic, antiandrogenic, antiestrogenic, and aryl hydrocarbon activity, and inhibitory hormonal signaling in adipocytes."[245]

Infants/children and lead

Lead and cadmium are toxic at very low exposure levels and have both acute and chronic effects on human health and the environment.[246] In 2006, The Intergovernmental Forum on Chemical Safety (IFCS) adopted a statement on mercury, lead, and cadmium urging IFCS participants and the International Conference on Chemicals Management (ICCM) to consider coordinated actions at the local, national, regional and global levels to protect human health and the environment.[247]

Even low exposure to lead may pose a health risk for children. A critical toxicological study from The German Human Biomonitoring Commission concluded that "it is not possible to identify a threshold blood lead level below which there are no cognitive deficits."[248] Lead paint is the primary source of exposure to lead for children in the U.S. because, "lead-paint is present in one-third of the

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[240] Asimakopoulos, A., Elangovan, M. and K. Kannan. "Migration of Parabens, Bisphenols, Benzophenone-Type UV Filters, Triclosan, and Triclocarban from Teethers and Its Implications for Infant Exposure." *Environmental Science and Technology*, 7 Dec. 2016, http://pubs.acs.org/doi/abs/10.1021/acs.est.6b04128.

[241] Kataria, A, et al. "Exposure to Bisphenols and Phthalates and Association with Oxidant Stress, InsulinN Resistance, and Endothelial Dysfunction in Children." *Pediatric Research*, 18 Jan. 2017, www.ncbi.nlm.nih.gov/pmc/articles/PMC5618435/.

[242] Vina, R., and CS Watson. "Bisphenol S Disrupts Estradiol-Induced Nongenomic Signaling in a Rat Pituitary Cell Line: Effects on Cell Functions." *Environmental Health Perspectives,* Mar. 2013, www.ncbi.nlm.nih.gov/pubmed/23458715.

[243] Rochester, JR. and AL. Bolden. "Bisphenol S and F: A Systematic Review and Comparison of the Hormonal Activity of Bisphenol A Substitutes." *Environmental Health Perspectives*, 16 Mar. 2015, http://ehp.niehs.nih.gov/1408989/.

[244] Thayer, KA, et al. "Bisphenol A, Bisphenol S, and 4-Hydroxyphenyl 4-Isoprooxyphenylsulfone (BPSIP) in Urine and Blood of Cashiers." *Environmental Health Perspectives,* Apr. 2016, www.ncbi.nlm.nih.gov/pubmed/26309242.

[245] Ibid. Rochester, JR. and AL. Bolden. "Bisphenol S and F: A Systematic Review." *Environmental Health Perspectives.*

[246] "Lead and Cadmium: Need for International Action?" The Center for International Law, Feb. 2008, www.who.int/ipcs/assessment/public_health/lyc_09.pdf.

[247] Ibid. "Lead and Cadmium…" The Center for International Law, 1.

[248] Ibid. "Lead and Cadmium..."The Center for International Law, 81.

nation's dwellings."[249] However, paint is not the only potential source of exposure. One report found that 34 percent of children in Los Angeles County with lead poisoning under the age of 6 had been exposed to items containing a high amount of lead including candy, toys and trinkets.[250] Tests conducted by a coalition of environmental health groups found that 35 percent of 1,200 tested children's products contained lead, many with levels far above the federal recall standard for lead paint.[251] In 2007 the toy maker Mattel recalled 0.75 million Chinese-made toys that were discovered with paint containing lead levels exceeding safety standards.[252]

Children are particularly vulnerable to lead poisoning for the reasons listed below:[253]

- The brain and neurological system of children continues to develop for several years after birth. Lead interferes with this developmental growth.
- Young children frequently put objects in their mouths, which can include paint chips, dirt, dust and contaminated water or food.
- Children's skin is thinner and thus lead is more easily absorbed through the skin.

In an intentional shift toward prevention of lead exposure, the CDC updated its recommendation on children's blood lead levels (BLL) in 2012 reducing the threshold for notifying parents of lead exposure from 10 to 5 micrograms per deciliter.[254] According to the CDC, "protecting children from exposure to lead is important to lifelong good health. No safe blood lead level in children has been identified… and effects of lead exposure cannot be corrected."[255] Evidence driving the CDC's policy change on lead came from the Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) stating BLLs of less than 10 are associated with IQ deficits, attention-related behaviors, as well as cardiovascular, immunological and endocrine effects.[256]

The ACCLPP also found that racial and income disparities exist and that "observed differences can be traced to differences in housing quality, environmental conditions, nutrition, and other factors."[257] Sociological factors that place a child in the high-risk category include members of minorities, a family that receives Medicaid, and having a sibling or playmate that has or has had lead poisoning.[258]

Infants/children and cadmium

Cadmium has been used as a replacement for lead in some products, but poses its own health risks. Cadmium is a heavy metal that occurs naturally in rocks and minerals. It can be released into the environment by burning of fossil fuels, waste incineration, smelting and via phosphate fertilizer

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[249] Ibid. "Lead and Cadmium…" The Center for International Law, IX.
[250] "Death of a Child After Ingestion of a Metallic Charm - Minnesota 2006." Center for Disease Control and Prevention, 31 Mar. 2006, www.cdc.gov/mmwr/preview/mmwrhtml/mm5512a4.htm.
[251] Ibid. "Lead and Cadmium..." The Center for International Law.
[252] Ibid. "Lead and Cadmium..." The Center for International Law.
[253] ibid. "Lead and Cadmium..." The Center for International Law.
[254] Ibid. "What Do Parents Need to Know..?" Centers for Disease Control and Prevention.
[255] Ibid. "What Do Parents Need to Know..?" Centers for Disease Control and Prevention.
[256] "Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention." Centers for Disease Control and Prevention, 4 Jan. 2012, www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf.
[257] Ibid. "Low Level Lead Exposure Harms..." Centers for Disease Control and Prevention.
[258] Ibid. "Low Level Lead Exposure Harms..." Centers for Disease Control and Prevention.

use. Typically food is the main exposure pathway to cadmium for humans. Cadmium exposure may result in adverse effects on the kidneys, liver, lungs, cardiovascular, immune and reproductive systems.[259]

A 2010 Associated Press study of 100 pieces of children's jewelry in New York, Ohio, Texas and California discovered that many had high levels of cadmium. For example, one trinket was 91 percent cadmium, and 12 percent of the pieces of jewelry contained at least 10 percent cadmium.[260] "The greatest potential for exposure comes from swallowing a jewelry piece. However, exposure to cadmium also occurs from repeated biting, sucking or mouthing the jewelry piece or from frequent hand-to-mouth contact after handling a jewelry piece. These behaviors are common in children younger than 6 years old."[261] Furthermore, "Eighty-eight of 111 PVC toys and other soft toys sampled from Delhi, Chennai, and Mumbai contained lead and cadmium in varying concentrations."[262]

The population at highest risk to cadmium toxicity are women with nutritional deficiencies or low blood iron, people with kidney disorders, and fetuses and children with low blood iron. Anyone with iron deficiency may be particularly vulnerable to cadmium toxicity because the body may compensate for this deficiency by increasing absorption of iron along with metals such as cadmium that are chemically similar to iron.[263] Maternal exposure to cadmium is associated with low birth weight and an increase of spontaneous abortion.[264] "A few studies in animals indicate that younger animals absorb more cadmium compared to mature animals. Animal studies also indicate that the young are more susceptible than mature to a loss of bone and decreased bone strength from exposure to cadmium."[265]

Children with low-level environmental cadmium exposure may have increased risks of learning disabilities. Studies in children have reported associations between higher cadmium levels and negative outcomes including mental retardation, decreased verbal IQ, lower neuropsychological test performance, learning disability, and behavioral problems in the presence of concurrently elevated lead levels.[266]

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[259] Fowler, BA. "Monitoring of Human Populations for Early Markers of Cadmium Toxicity: A Review." *Toxicology and Applied Pharmacology*, 1 Aug. 2009, www.sciencedirect.com/science/article/pii/S0041008X09001896.
[260] "Perfectly Legal: Toxic Cadmium, up to 91%, Added to Kids' Jewelry as China Gets Lead Out." *Associated Press*. 10 Jan. 2010, www.cleveland.com/world/index.ssf/2010/01/perfectly_legal_toxic_cadmium.html.
[261] "Cadmium in Children's Jewelry." New York State, Feb. 2011, www.health.ny.gov/environmental/chemicals/cadmium/cadmium_jewelry.htm.
[262] Ibid. "Low Level Lead Exposure Harms..." Centers for Disease Control and Prevention, 10.
[263] Kim Y. and Park, S. "Iron Deficiency Increases Blood Concentrations of Neurotoxic Metals in Children." *Korean journal of Pediatrics*, 57(8), pp. 345-50, 2014. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4155178/.
[264] Ibid. "Lead and Cadmium..."The Center for International Law.
[265] "ATSDR Public Health Statement: Cadmium." Agency for Toxic Substances and Disease Registry, Sep. 2012, www.atsdr.cdc.gov/ToxProfiles/tp5-c1-b.pdf.
[266] Ciesielski, T, et al. "Cadmium Exposure and Neurodevelopmental Outcomes in U.S. Children." *Environmental Health Perspectives*, May 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC3346779/.

"Urinary cadmium concentrations were generally higher among non-Hispanic black and Mexican-American children than among white children, and higher among children from more impoverished households or households where the reference person had lower educational achievement."[267]

Low-income populations and discount retail outlets

Research suggests that dollar stores have many products that are above chemical levels of concern. Dollar stores are frequented for food and other essential household products in low-income communities. Retail research shows that 40 percent of dollar store shoppers have annual household incomes of less than $25,000.[268] One recent study of 164 dollar stores found that 81 percent of the products tested (133 of 164) contained at least one hazardous chemical above levels of concern.[269] Further, 38 percent of the products tested (63 of 164) contained the toxic plastic PVC (vinyl); 32 percent of vinyl products tested for phthalates (12 of 38) contained levels of regulated phthalates above the Consumer Product Safety Commission's recommended limit for children's products.[270] Other retailers were not included in the study.

Federal regulatory context

While the Consumer Product Safety Commission is the primary agency responsible, there are other federal agencies that regulate chemicals in children's products. For example, products containing pesticides, and industrial chemicals used to manufacture children's products in the U.S. are regulated by the Environmental Protection Agency, and children's cosmetics and medicated personal care products by the Food and Drug Administration.

Consumer Product Safety Act

Many chemical constituents in children's products are regulated under the Consumer Product Safety Act. First introduced in 1972, this legislation was designed to protect the public against unreasonable risks associated with consumer products, develop uniform safety standards for products, and study and prevent product-related illnesses and injuries. The Consumer Product Safety Act also created the Consumer Product Safety Commission (CPSC), an independent federal regulatory agency authorized to require cautionary labeling of hazardous household products that might cause personal injury or illness as a result of reasonably foreseeable handling, use, or ingestion. Hazardous substances may be banned or regulated where labels alone fail to provide sufficient protection and products intended for children may be banned for containing hazardous chemicals.

The CPSC has jurisdiction over more than 15,000 types of consumer products used in and around the home, in recreation, and in schools, from children's toys to portable gas generators and toasters. The CSPC issues voluntary and mandatory standards, but primarily relies on industry associations to offer and negotiate standards that address product labeling, recall/repair of products, research on hazards, and distribution of consumer safety information. CPSC selects a product hazard for

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[267] Ibid. Ciesielski, T, et al. "Cadmium Exposure and Neurodevelopmental Outcomes...." *Environmental Health Perspectives*.
[268] Peterson, Hayley. "Dollar Store Shoppers are Much Poorer than Wal-Mart's Customers." *Business Insider,* 19 Sep. 2014, www.businessinsider.com/dollar-store-shopper-demographics-2014-9.
[269] "A Day Late and a Dollar Short: Discount Retailers Are Falling Behind on Safer Chemicals." Campaign for Healthier Solutions, Feb. 2015, http://ej4all.org/assets/media/documents/Report_ADayLateAndADollarShort.pdf.
[270] Ibid. "A Day Late and a Dollar Short..." Campaign for Healthier Solutions.

review based on public petitions, referrals from other agencies, congressional requests or staff initiatives.

Driven by public demand for reform, the Consumer Product Safety Improvement Act of 2008 established independent testing for all children's products and requires supplier certification when products must meet standards. Amended again in 2011, the CPSC was given discretion in testing and ability to exempt previously manufactured children's products and toys under specific circumstances, e.g. resale of used items.

Western U.S. regulatory context and local action

Oregon

The Oregon Legislature passed the Toxic-Free Kids Act in 2015. The law requires manufacturers to report products containing high priority chemicals of concern for children's health.[271] The definition of children's products that is required under ORS 431A.250 is narrowly defined as products made for, marketed for use by or marketed to children under 12 years of age including products "designed or intended by the manufacturer to facilitate sucking, teething, sleep, relaxation, feeding or drinking, children's clothing and footwear, car seats, children's cosmetics, children's jewelry and toys, with some exclusions."[272] Under ORS 431A.253, those products containing High Priority Chemicals of Concern for Children's Health (HPCCCH) above the determined thresholds must be reported.[273] The law also requires manufacturers to remove these chemicals from certain products or seek a waiver. This law is based largely on Washington's Children's Safe Product Act, initially starting with the same list of priority chemicals.

Washington

In 2008, the Children's Safe Products Act[274] was passed (HB2647). This law limits the use of lead, cadmium, and six different phthalates in children's products sold in Washington. It also limits the use of flame retardants in children's products and upholstered furniture, and requires manufacturers to report the use of Chemicals of High Concern to Children[275] in their children's products. Stemming from this legislation, in 2011 (and updated in 2017), Washington adopted the Children's Safe Products Reporting Rule[276] which defined the list of chemicals, established manufacturers' compliance rules and clarified the enforcement processes.

Washington State has passed (or is currently considering) the following legislation related to children's products:

- SB 6248[277] passed in 2009 to ban BPA from children's food and beverage containers, other than metal cans, and all reusable water bottles.

[271] Ibid. "High Priority Chemicals of Concern for Children." Oregon Health Authority.
[272] Ibid. "ORS 431A.250." Oregon Legislature.
[273] Ibid. "ORS 431A.253." Oregon Legislature.
[274] Ibid. "Children's Safe Products Act." Washington State Department of Ecology.
[275] Ibid. "Chemicals of High Concern Reporting." Washington Department of Ecology.
[276] Ibid. "Children's Safe Product Reporting Rule." Washington State Department of Ecology.
[277] Ibid. "Washington SB 6248." Washington State Legislature, 2009.

- HB 2545/SB 6440[278] passed in 2016 to ban the sale of children's products and residential furniture containing the flame retardants TDCPP and TCEP.
- HB 2632 (currently going through the legislative process[279]) would prohibit the sale of children's products and upholstered furniture that contain organohalogen flame retardants and would require the disclosure of high priority chemicals in children's products, including electronics. This appears to be an update to prior legislation. Previously this law only required reporting of chemicals and fell short of actively banning them from products.

California

Safer Consumer Products Program

California launched the Safer Consumer Products (SCP) Program[280] in 2013, a green chemistry initiative with the goal to reduce the toxic chemical exposure from everyday product use and to participate in promoting the development and technology around greener products. Children's products fit within the scope of the SCP. Currently the only children's product-specific regulation under SCP is for children's foam-padded sleeping products.[281] The products with toxic flame retardants, TDCPP (tris(1,3-dichloro-2-propyl) phosphate) or TCP (1,2,3-Trichloropropane), were added to the SCP's priority product list.[282]

The overall process the program takes includes the following:[283]

1. SCP identifies which chemicals pose health or environmental hazards. These are called "Candidate Chemicals."
2. SCP identifies the products that contain the chemicals of concern. These are called "Priority Products."[284]
3. The companies that make the Priority Product will evaluate their use of hazardous chemicals in their products by using an alternatives analysis process, which involves examining safer alternatives to chemicals of concern.[285]
4. SCP issues a regulatory response.
5. Companies make adjustments to the products based on the regulatory response requirements.

The SCP recently released its 2018-2020 work plan.[286]

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[278] Ibid. "Washington State 2545 / SB 6440." Washington State Legislature, 2016.
[279] Ibid. "Washington State HB 2632." Washington State Legislature, 2017.
[280] Ibid. "Safer Consumer Products Program." California Department of Toxic Substances Control.
[281] "Children's Foam-Padded Sleeping Products with TDCPP or TCEP as a Priority Product - Effective July 1, 2017." California Department of Toxic Substances Control, https://dtsc.ca.gov/scp/childrens-foam-padded-sleeping-products-with-tdcpp-or-tcep/.
[282] "SCP Foam-padded sleeping products FAQs." California Department of Toxic Substances Control, www.dtsc.ca.gov/SCP/upload/SleepFAQs.pdf.
[283] Ibid. Singla, Veena. "New California Program Is on a Mission to Reduce Toxic Chemicals in Our Everyday Products."
[284] Ibid. "What is a Priority Product?" California Department of Toxic Substances Control.
[285] Ibid. Singla, Veena. "Selecting Safer Alternatives To Toxic Chemicals And Ensuring The Protection Of The Most Vulnerable: A Discussion."

Phthalate bans and other legislation
As of 2009, California banned "the manufacture, sale, and distribution of any toy or child care product that contains more than 0.1 percent" of three types of phthalates." Within this ban, is a 'requirement' for manufacturers to not replace phthalate with an equally toxic chemical, though regulation of this was unclear.[287]

California has passed (or is currently considering) the following legislation related to children's products:

- In 2018, AB 2998[288] was adopted to ban flame retardants in juvenile products, mattresses or upholstered furniture.
- In 2010, SB 929[289] was adopted which bans cadmium in children's jewelry.
- In 2008, AB 2901[290] was adopted to ban jewelry unless it was made of class 1 compounds (jewelry made with various low-toxic level metals, glass, ceramic, crystals, gemstones, fabric, rope string or elastic among other similar materials), class 2 (metal alloys or other materials containing low lead levels, unplated metal, plastic, rubber polystyrene or stone beads) or class 3 materials (when portion of material meets certain lead criteria or does not fall into class 1 or 2 materials).

Regulatory context and action in other regions of the U.S.

Rhode Island, Maine and Vermont
Rhode Island, Maine and Vermont are other states where there is strong legislation around toxic chemical in children's products.

The following legislation has been enacted in Rhode Island (information is quoted directly from Safer States Rhode Island webpage):[291]

- HB5823: Prohibits the manufacture and sale of reusable food and beverage containers containing bisphenol-A, of any food intended for children packaged in packaging that includes bisphenol-A, requires labeling of all food packaging [containing] bisphenol-A, and prohibits replacement with toxic alternatives.
- HB7369: Prohibits the manufacture and sale of reusable food and beverage containers containing food intended for children packaged in materials containing bisphenol-A.

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[286] "Priority Product Work Plan." California Department of Toxic Substances Control, https://dtsc.ca.gov/scp/priority-product-work-plan/.
[287] Hileman, Bette. "California Bans Phthalates in Toys." *Chemical and Engineering News*, 22 Oct. 2007. www.pubs.acs.org/doi/abs/10.1021/cen-v085n043.p012a.
[288] "AB-2998 Consumer products: flame retardant materials." State of California, September, 2018, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2998.
[289] "California SB 929." California Legislature, www.legislature.ca.gov/cgi-bin/port-postquery?bill_number=sb_929&sess=0910&house=B&author=pavley.
[290] "California AB 2901." *LegInfo*, www.leginfo.ca.gov/pub/07-08/bill/asm/ab_2901-2950/ab_2901_bill_20080929_chaptered.html.
[291] "States in the Lead: Rhode Island." *Safer States*, www.saferstates.com/states-in-the-lead/rhode-island/.

- HB 5822: Prohibits the manufacture and sale of children's products containing formaldehyde and any toxic replacements.
- H5082 / S0166: Prohibits the manufacture and sale of children's products and residential upholstered bedding or furniture containing toxic flame retardants. (Adopted in 2017)

The following is legislation enacted in Maine (information is quoted directly from Safer States Maine webpage):[292]

- Board of Environmental Protection Action:[293] Designates BPA as a priority chemical, requires makers of BPA-containing formula and baby food containers, and children's toys and products, to report on usage, and plan for its replacement. Bans BPA from reusable food and beverage containers, and formula and baby food packaging. (Adopted in 2013)
- LD 1129: Selects up to seventy chemicals as Chemicals of High Concern based upon likely exposure to children or fetuses, and uses this list to designate Priority Chemicals which will require reporting and disclosure when used in children's products. (Adopted in 2011)
- LD 2053: Tests children's products for lead, informs public of results, and requests products be removed from shelves. (Adopted in 2008)

The following is legislation enacted in Vermont (information is quoted directly from Safer States Vermont webpage):[294]

- S 247: Bans BPA from formula and baby food jars, as well as all reusable food and beverage containers. (Adopted in 2010)
- S 261: Bans phthalates from children's products, and specifies that they can't be replaced with known or possible carcinogens. (Adopted in 2008)
- S 152: Bans the manufacture and sale of any children's product containing lead. (Adopted in 2008)
- S 81 / H 241: Bans the flame retardants OctaBDE and PentaBDE from all products, bans the sale of mattresses and furniture with decaBDE, and bans Tris (TCEP & TDCPP) from children's products and furniture. (Adopted in 2013)

In 2014 Vermont passed Act 188, Relating to the Regulation of Toxic Substances, which, like Oregon's Toxic Free Kids Act is modeled after Washington State Children's Safe Product Act and requires disclosure of high priority chemicals to children's health.[295] Vermont's program goes a step further than both Washington and Oregon by requiring companies report at the level of the specific brand name and product model, or the specific UPC code, not just at the level of the product category by Global Product Classification Brick. In theory, this better informs consumer decision-making regarding the purchase of specific children's products.

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[292] "States in the Lead: Maine." *Safer States*, www.saferstates.com/states-in-the-lead/maine/.
[293] "Welcome to the Board of Environmental Protection." State of Maine, www.maine.gov/dep/bep/.
[294] "States in the Lead: Vermont." http://www.saferstates.com/states-in-the-lead/vermont/.
[295] "S.239 (Act 188), An act relating to the regulation of toxic substances." Vermont General Assembly, June 2014. https://legislature.vermont.gov/bill/status/2014/S.0239.

The Interstate Chemicals Clearinghouse (IC2) and the High Priority Chemicals Data System

The IC2 is currently building the High Priority Chemicals Data System to collect and manage the disclosure data required by the children's product laws in the states of Washington, Oregon and Vermont. As additional states enact their own similar laws, the new data system will be capable of adding them in, reducing duplication and increasing efficiency of government chemicals policy implementation.[296]

[296] "High Priority Chemicals Data System & Data Flow Request for Proposals." Interstate Chemicals Clearinghouse, March 2018. http://www.theic2.org/article/download-pdf/file_name/NEWMOA_IC2_HPCDS_RfP_FINAL.pdf.

Community health risk and regulatory context of chemicals in

Cleaning products for the home

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: Reviewed here are cleaning products writ large - which may contain several chemicals - with narrower investigation of risks associated with volatile organic compounds, nonylphenol and nonylphenol ethoxylates, air fresheners and fragrance, and triclosan. Associated health impacts identified (but not necessarily specifically linked to cleaning products) include allergies, asthma, various cancers, endocrine disruption, reproductive harm and poisoning from acute exposures. Research suggests women, fetuses, infants and toddlers experience heightened risk from chemicals in cleaning products. Women are more likely than men to clean in the household and hold positions as professional cleaners. Pregnant women who clean for a living have children with higher than average rates of birth defects. Infants and toddlers are disproportionately exposed through hand to mouth transmission of chemicals from the surface of floors and furniture.

Regulatory context: Household cleaning products are subject to federal labeling, hazard communication and registration requirements managed by a variety of agencies and authorized by many acts including the Consumer Product Safety Commission, the Federal Hazardous Substances Act, the Environmental Protection Agency under the Federal Insecticide, Fungicide and Rodenticide Act, the Food and Drug Administration under the Federal Food, Drug and Cosmetic Act, the Consumer Products Rule and the Clean Air Act. New York State launched the Household Cleansing Product Information Disclosure Program in 2017. Also in 2017, California passed its own cleaning product ingredient disclosure legislation that is similar to the New York program. Oregon doesn't have household cleaning products legislation, though attempts have been made. A Product Stewardship bill for Household Hazardous Wastes championed by Metro includes highly corrosive cleaning products and is under consideration in the 2019 session of the Oregon Legislature.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals)

and non-chemical stressors (such as from racism or socioeconomic status).[297] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Fetuses, infants and toddlers and cleaning products (writ large)

In the home, children are disproportionately impacted by cleaning chemicals. Compared to adults, children are smaller and lighter in weight - chemical exposure for children can therefore result in greater concentrations of contaminants in their bodies. Many of the chemicals in cleaning products are able to cross the placental wall, reaching developing fetus' organs and brain.[298] Exposures in utero and during infancy can be dramatically more harmful than in later childhood when the body's defense systems are completely developed. In addition, a porous blood-brain barrier and lower levels of binding proteins in children allow chemicals to reach the brain and organs more easily than for adults.[299] Early exposure to chemicals can develop into chronic diseases in adulthood.[300]

In addition to long-term health impacts from chronic exposures, poisonings from acute exposure to cleaning chemicals are a significant impact. In 2015, cleaning products were responsible for almost 8 percent of all toxic exposures reported to U.S. Poison Control Centers, accounting for 195,974 calls. Household cleaners were the second most common reason, behind medications, for human exposure. Of all calls to the poison control centers about toxic exposure, 115,701 incidents involved children under 6 years old, who can swallow or spill cleaners stored or left open inside the home.[301]

Concerns about impacts of household chemicals on children is a global issue. In Hong Kong, 2,299 children attending 21 primary schools were studied, and increased total chemical burden in study participants was associated with both high chemical cleaner use and high rates of rhinitis.[302]

Persistent early childhood wheezing has also been linked to prenatal exposure to chemicals in home cleaning products in the U.K. Youth whose mothers had an especially high toxic chemical burden were more than twice as likely to experience persistent early childhood wheezing.[303] The children of cleaning workers are also born with higher rates of cleft palates[304] and Down Syndrome.[305]

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[297] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[298] "Cleaning Products and Your Health." *Women's Voices for the Earth*, www.womensvoices.org/safe-cleaning-products/safe-cleaning-fact-sheets/cleaning-products-health/.

[299] "Body Burden: The Pollution in Newborns." Environmental Working Group, Jul. 2005, www.ewg.org/research/body-burden-pollution-newborns#.Wt4GC9PwbOQ.

[300] Landrigan, PH and LR Goldman. "Children's Vulnerability To Toxic Chemicals: A Challenge And Opportunity To Strengthen Health And Environmental Policy." *Health Affairs,* May 2011, www.healthaffairs.org/doi/full/10.1377/hlthaff.2011.0151.

[301] Mowry, JB, et al. "2015 Annual Report of the American Association of Poison Control Centers' National Poison Data System." *Clinical Toxicology*, 22 Dec. 2016, www.tandfonline.com/doi/abs/10.1080/15563650.2016.1245421.

[302] Mowry, JB, et al. "Frequent Use of Household Cleaning Products is Associated with Rhinitis in Chinese Children." *The Journal of Allergy and Clinical Immunology*, Sep. 2016, www.jacionline.org/article/S0091-6749(16)30254-8/fulltext.

[303] Sherriff, et al. "Frequent Use of Chemical Household Products Is Associated with Persistent Wheezing in Pre-School Age Children." *Thorax*, BMJ Publishing Group Ltd, 1 Jan. 2005, www.ncbi.nlm.nih.gov/pmc/articles/PMC1747149/.

[304] Chevrier, et al. "Occupational Exposure to Organic Solvent Mixtures during Pregnancy and the Risk of Non-Syndromic Oral Clefts." *Occupational & Environmental Medicine*, 1 Sept. 2006, www.oem.bmj.com/content/63/9/617.short.

[305] Olshan, A F, et al. "Paternal Occupational Exposures and the Risk of Down Syndrome." *American Journal of Human Genetics*, May 1989, www.ncbi.nlm.nih.gov/pubmed/2523192.

Urban populations and sources of outdoor volatile organic compounds
A 2018 study found that the use of volatile chemical products (VCPs)—including cleaning agents, pesticides, coatings, printing inks, adhesives and personal care products—now constitutes half of fossil fuel VOC emissions in industrialized cities in the U.S., and exceeds that from vehicle fuel emissions.[306] These emissions are largely from indoor use of VCPs in residential and commercial buildings.

Infants and toddlers and volatile organic compounds
Volatile Organic Compounds (VOCs) are found in products ranging in the thousands. Some of the most common products containing VOCs include aerosol sprays, cleaners and disinfectants. Indoor air concentrations of VOCs can be 2 to 5 times greater than outdoors, and VOCs can persist in the air. Researchers have documented short and long-term health effects from VOC exposure such as irritation to the mucus membranes, headache, loss of coordination, liver and kidney damage, and endocrine disruption. Some VOCs have been linked to cancer in animals and humans.[307] One study of children between 6 months and 3 years in Australia showed a strong association between indoor home exposure to VOCs and increased risk of asthma. Children exposed to total VOCs at levels of greater than 60 mg/m^3 are four times more likely to have asthma than those who were not exposed to such levels, while children exposed to a single compound such as benzene at levels of greater than 20 mg/m^3 were eight times more likely to have asthma. From this study, the "findings support the hypothesis that exposure to indoor pollutants might be important in the genesis of asthma."[308]

Mothers, babies and air fresheners with fragrance
In a population-based U.S. study, 35 percent of the population reported health problems, such as migraine headaches and respiratory difficulties, when exposed to fragranced products. Further, 15 percent of the population reported lost workdays or a job due to fragranced product exposure in the workplace.[309] Use of air fresheners and aerosol sprays were associated with 25 percent more headaches and a 19 percent increased chance of depression in mothers. Babies exposed to air fresheners in the home experienced 30 percent more ear infections and were 22 percent more likely to experience diarrhea.[310,311]

Women (as primary household cleaners and maids) and cleaning products (writ large)
Women frequently perform a disproportionate amount of housework compared to men, including cleaning. One study found that men reported performing 42.3 percent of housework, while women

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[306] Ibid. "Volatile chemical products emerging as largest petrochemical source of urban organic emissions." *Science*.
[307] "Volatile Organic Compounds' Impact on Indoor Air Quality." Environmental Protection Agency, www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality.
[308] Ibid. Rumchev, K, et al, "Association of Domestic Exposure to Volatile Organic Compounds with Asthma in Young Children."
[309] Steinemann, Anne. "Fragranced Consumer products: Exposures and Effects From Emissions." *Air Quality, Atmosphere & Health*, 2016, www.link.springer.com/article/10.1007%2Fs11869-016-0442-z.
[310] Edwards, Rob. "Far From Fragrant." *News Scientist*, 4 Sep. 1999, www.newscientist.com/article/mg16322022-700-far-from-fragrant/.
[311] Farrow, A, et al. "Symptoms of Mothers and Infants Related to Total Volatile Organic Compounds in Household Products." *Archives of Environmental Health*, Aug. 2010, www.tandfonline.com/doi/abs/10.3200/AEOH.58.10.633-641.

reported performing as much as 79.8 percent.[312] In addition, the cleaning workforce (maids and housekeeping cleaners) are 90 percent women.[313]

A study of 638 females found significant associations between weekly use of two or more household cleaning agents in spray form and higher rates of asthma.[314] Similar results were found in a longitudinal study of 3,503 European women, where weekly use of cleaning sprays was associated with higher incidence of asthma; this increased significantly for participants using sprays at least 4 days a week. Asthma incidence was not associated with liquid cleaning products (not applied in spray form).[315]

Exposure to cleaning products has been shown to have long-term negative effects on women's lung function. Compared to other professions, women who clean for a living have twice the risk of lung cancer[316] and increased rates of adult onset asthma and exacerbation of asthma.[317] For example, in a multi-center population-based cohort study, women were surveyed over the course of 20 years to find that lung function[318] declined more rapidly in the women who were responsible for household cleaning. Cleaning did not have the same association with declining lung function for men in the study, suggesting less exposure in women is needed to reduce risk of negative health outcomes.[319] A study in Norway found long-term respiratory impairment 10 to 20 years later for women cleaning occupationally *and* in the home, with observed health outcomes similar to people smoking a pack of cigarettes a day for 10 years.[320] In a study of Swiss adults, long-term ongoing use of household spray cleaning products was associated with reduced heart rate variability (HRV), an indication of physiological stress. This association was strongest in older women with a history of pulmonary conditions.[321]

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[312] Bird, CE. "Gender, Household Labor, and Psychological Distress: The Impact of the Amount and Division of Housework." *Journal of Health and Social Behavior*, Mar. 1999, www.ncbi.nlm.nih.gov/pubmed/10331320.
[313] Rochelau, Matt. "Chart: The Percentage of Women and Men in Each Profession." *Boston Globe,* Mar. 2017, www.bostonglobe.com/metro/2017/03/06/chart-the-percentage-women-and-men-each-profession/GBX22YsWl0XaeHghwXfE4H/story.html.
[314] Moual, Nicole Le, et al. "Domestic Use of Cleaning Sprays and Asthma Activity in Females." *European Respiratory Journal*, 2012, www.pdfs.semanticscholar.org/3b04/44537d2a371978985cb417c42cf35bb991a6.pdf.
[315] Zock, JP, et al. "The Use of Household Cleaning Sprays and Adult Asthma An International Longitudinal Study." *American Journal of Respiratory and Critical Care Medicine*, 15 Oct. 2007, www.atsjournals.org/doi/full/10.1164/rccm.200612-1793OC.
[316] Atramont, A, et al. "Professional Cleaning Activities and Lung Cancer Risk Among Women: Results from the ICARE Study." *Journal of Occupational and Environmental Medicine*, June 2016, www.ncbi.nlm.nih.gov/pubmed/27206119.
[317] Siracusa, A, et al. "Asthma and Exposure to Cleaning Products – a European Academy of Allergy and Clinical Immunology Task Force Consensus Statement." *European Journal of Allergy and Clinical Immunology*, Dec. 2013, www.ncbi.nlm.nih.gov/pubmed/24131133.
[318] Ibid. "FEV1 and FVC: What Do They Mean..." *The Lung Institute.*
[319] Svanes, Olstein, et al. "Cleaning at Home and at Work in Relation to Lung Function Decline and Airway Obstruction." American Thoracic Society, www.thoracic.org/about/newsroom/press-releases/resources/women-cleaners-lung-function.pdf.
[320] Svanes, Olstein, et al. "Cleaning at Home and at Work in Relation to Lung Function Decline and Airway Obstruction." *American Journal of Respiratory and Critical Care Medicine*, May 1, 2018. www.atsjournals.org/doi/full/10.1164/rccm.201706-1311OC.
[321] Mehta, AJ, et al. "Heart Rate Variability in Association with Frequent Use of Household Sprays and Scented Products in SAPALDIA." *Environmental Health Perspectives*, 22 Apr. 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC3404664/.

Fetuses and nonylphenol and nonylphenol ethoxylates

Toxic nonylphenol (NP) and nonylphenol ethoxylates (NPEs) found in "laundry detergents, personal hygiene, automotive, latex paints, and lawn care products"[322] are endocrine disrupting chemicals, and intrauterine exposure has been linked with decreased fetal body length at birth, babies who are small for gestational age, and low maternal weight gain.[323] Women with regular dermal exposure to NP-containing cleaning products have shown measurable levels of NP in their breast milk.[324]

Healthcare settings and antimicrobial soap

Widespread use of antimicrobials, including triclosan, has been linked to the development of antimicrobial resistance in bacteria.[325] In December 2017, the FDA finalized a ban on triclosan use as a health care antiseptic, mandating that it could no longer be used in medical settings without pre-market review.[326] In the near future, the FDA ban is unlikely to extend beyond use in healthcare settings. However, the development of resistant bacteria is a population-based risk wherever antimicrobials are in widespread use, including homes, offices, daycares and community centers.

Federal regulatory context

Household cleaning products are subject to federal labeling, hazard communication and/or registration requirements promulgated by a variety of agencies. Which regulations and requirements products may be subject to depends largely on how they are marketed to consumers.[327] Cleaning products marketed to institutional and commercial facilities for use by employees are regulated by the Occupational Safety and Health Administration (see *Workplace exposures in the service sector* for detail.)

The Consumer Product Safety Commission (CPSC) regulates all chemical cleaning products (except pesticides) that are defined as hazardous substances under the Federal Hazardous Substances Act. CPSC labeling requirements apply to all products containing any hazardous substance and if such substance may cause substantial injury or illness. The products must also, under customary or reasonably foreseeable use, be brought into or around a house or home. Under the Poison Prevention Packaging Act of 1970, substances that present a significant hazard to children must be packaged in accordance with CPSC package effectiveness specifications.

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[322] "Fact Sheet: Nonylphenols and Nonylphenol Ethoxylates." Environmental Protection Agency, www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-nonylphenols-and-nonylphenol-ethoxylates.
[323] Tsai, MS, et al. "Neonatal Outcomes of Intrauterine Nonylphenol Exposure—A Longitudinal Cohort Study in Taiwan." *Science of the Total Environment*, 1 Aug. 2013, www.sciencedirect.com/science/article/pii/S0048969713004610.
[324] Sise, S. and C. Uguz. "Nonylphenol in Human Breast Milk in Relation to Sociodemographic Variables: Diet, Obstetrics Histories and Lifestyle Habits in a Turkish Population." *Iranian Journal of Public Health*, Apr. 2017, www.ncbi.nlm.nih.gov/pmc/articles/PMC5439038/.
[325] Yazdankhah, SP. "Triclosan and Antimicrobial Resistance in Bacteria: An Overview." *Microbial Drug Resistance*, Summer 2006, www.ncbi.nlm.nih.gov/pubmed/16922622.
[326] "21 CFR Part 310." U.S. Food and Drug Administration, 14 Dec. 2017, www.s3.amazonaws.com/public-inspection.federalregister.gov/2017-27317.pdf.
[327] Wagner, Daniel. "General Guide to Chemical Cleaning Product Regulation." International Sanitary Supply Association, Inc., 2000, www.issa.com/data/moxiestorage/regulatory_education/regulatory-reference-library/general-chemical-cleaning-product-regulation.pdf.

The Environmental Protection Agency, under the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) requires registration of all products that claim to "prevent, destroy, repel, or mitigate any pest," including harmful microorganisms, allergens and their habitat. In general, antimicrobial pesticides used on inanimate surfaces, such as disinfectants and sanitizers, are subject to the EPA pesticide regulations. Materials must comply with labeling requirements and all incidents adversely affecting humans or other non-target organisms must be reported to the EPA.

The Food and Drug Administration (FDA) regulates hand sanitizers and soaps under the Federal Food, Drug & Cosmetic Act. These are considered drugs "because they are intended and labeled for topical antimicrobial use to prevent disease in humans." Soaps and sanitizers must be approved as safe and effective in Over the Counter Drug Review process. Products that sterilize personal medical equipment are also regulated by the FDA as general purpose disinfectants.

Twenty-four categories of institutional and household consumer cleaning products containing volatile organic compounds are subject to concentration limits established in the Consumer Products Rule administered by the EPA under the Clean Air Act.

The Federal Hazardous Substances Act (FHSA) requires precautionary labeling on the immediate container of hazardous household products to help consumers safely store and use those products and to give them information about immediate first aid steps to take if an accident happens. The FHSA also allows the Consumer Product Safety Commission to ban certain products that are so dangerous that the labeling the act requires is not adequate to protect consumers. The FHSA only covers products that, during the reasonably foreseeable purchase, storage, or use, may be brought into or around a place where people live. Products used or stored in a garage, shed, carport or other building that is part of the household are also covered. The Act requires hazardous household products ("hazardous substances") to bear labeling that alerts consumers to the potential hazards that those products present and that tells them what they need to do to protect themselves and their children from those hazards.

To require labeling under FHSA, a product must first be toxic, corrosive, flammable or combustible, an irritant, a strong sensitizer, or it must generate pressure through decomposition, heat or other means. Second, the product must have the potential to cause substantial personal injury or substantial illness during or as a result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children.

There are no formal guidelines to evaluate exposure to a product and the risk of injury it may present. FHSA allows the CPSC to ban a hazardous substance if the CPSC determines that the product is so hazardous that the cautionary labeling required by the act is not adequate to protect the public. The CPSC has banned liquid drain cleaners that contain 10 percent or more by weight sodium or potassium hydroxide and that are not packaged in child-resistant packaging.[328] The Lowell Center for Sustainable Production (University of Massachusetts) finds that FHSA's ambiguous definition of "substantial" illness, strict risk-based decision making and the lack of

[328] "Federal Hazardous Substances Act (FHSA) Requirements." U.S. Consumer Product Safety Commission, www.cpsc.gov/Business--Manufacturing/Business-Education/Business-Guidance/FHSA-Requirements/.

available data on illness arising from exposure means that many chemicals remain unlisted as hazardous in products.[329]

In general, companies make the determination as to whether their product contains a hazardous substance, though in some rare cases, the CPSC may issue a regulation defining a particular chemical or substance as hazardous. The CPSC has developed regulatory definitions of acute toxicity as well as voluntary guidelines to assist companies in determining the hazards of substances in their products (so as to comply with FHSA) including carcinogenicity, neurotoxicity, reproductive/ developmental toxicity, exposure, bioavailability, risk assessment, and acceptable risk. However, for many substances very little toxicological data exists. If data do not exist to document a risk, then the substance is not considered hazardous.[330] Given that the law requires evidence that a product causes substantial illness before it is labeled as hazardous, and companies are self-determining hazard according to voluntary guidelines, requirements are inconsistently applied in practice and consumer risk may be much greater than recognized.

Western U.S. regulatory context and local action

Oregon

Oregon does not specifically have legislation around household cleaning products. There are a number of programs, such as those through the City of Portland and Metro that provide basic education around healthy cleaning products.[331]

Beyond Toxics,[332] an environmental justice advocacy organization based in Eugene has a Green Home Cleaning Campaign[333] where they have pulled together the latest research on their website and include a "Hall of Shame" list of the most toxic cleaners.[334]

Oregon HB 3251-1 a Product Stewardship for Household Hazardous Wastes bill - championed by Metro - did not pass in the 2018 session but is being reintroduced in the 2019 session and includes highly corrosive cleaning products among the products it would cover. The bill would require manufacturers to set up and pay for convenient hazardous waste take-back locations and processes for leftover chemical products, reducing exposures to people and the environment.

Extended producer responsibility and household hazardous waste legislation

Most of the legislation related to home cleaning products in Oregon is focused on taking an extended producer responsibility (EPR) approach to household hazardous waste (HHW), an umbrella under which highly corrosive toxic household cleaning supplies are included. In 2015, HB 3251-1, Product Stewardship for Household Hazardous Wastes legislation was proposed in the

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[329] Tickner, Joel. "Presumption of Safety: Limits of Federal Policies on Toxic Substances in Consumer Products." Lowell Center for Sustainable Production, Feb. 2008, p. 9, www.chemicalspolicy.org/downloads/UMassLowellConsumerProductBrief.pdf.
[330] Ibid. Tickner, Joel. "Presumption of Safety." Lowell Center for Sustainable Production.
[331] "Green Cleaners 101." City of Portland, www.portlandoregon.gov/sustainabilityatwork/article/461331.
[332] "About Us." *Beyond Toxics*, www.beyondtoxics.org/about/.
[333] "Green Home Cleaning Campaign." *Beyond Toxics*, www.beyondtoxics.org/work/green-home-cleaning-campaign/.
[334] "Hall of Shame." Environmental Working Group, 2012, www.static.ewg.org/reports/2012/cleaners_hallofshame/cleaners_hallofshame.pdf.

Oregon legislature, championed by Metro.[335] Metro held three stakeholder meetings in 2016 and 2017 to gain perspectives on the proposal.[336] HB 4126A, the Household Hazardous Waste Stewardship bill was introduced in the 2018 session and did not pass. HB 4126A is being reintroduced with minor clarifying revisions in the 2019 legislative session. The bill would require manufacturers to set up and pay for convenient hazardous waste take-back locations and processes for leftover chemical products, reducing exposures to people and the environment.

Green chemistry

The EPA defines green chemistry as "the design of chemical products and processes that reduce or eliminate the generation of hazardous substances. Green chemistry can be applied across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal."[337] Green chemistry initiatives could encourage product developers to design healthier and more sustainable products.[338]

There has been movement towards green chemistry regulation in Oregon since at least 2011 when the Oregon Green Chemistry Advisory Group (OGCAG) - convened by The Oregon Environmental Council (OEC) - published a foundational report.[339] [340] Members of the OGCAG included Oregon Department of Environmental Quality (ODEQ), Business Oregon (Oregon Business Development Department), Oregon Manufacturing Extension Partnership (OMEP), University of Oregon, Portland State University, and business leaders from Nike, Inc., Blount International, Inc., and Coastwide Laboratories.

The OGCAG developed a set of recommendations which led to an Executive Order. On April 27, 2012, Governor Kitzhaber signed Executive Order No. 12-05, "Fostering Environmentally-Friendly Purchasing and Product Design,"[341] which has been described (within the media and government offices) as a "green chemistry executive order."[342] DEQ describes actions resulting from the Executive Order as those actions leveraging state purchasing power to encourage innovation.[343] The Executive Order was created to establish policy around environmental purchasing and product design.

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[335] "Product Stewardship for Household Hazardous Wastes Overview of HB 3251-1." Metro, 19 Jan. 2016, www.oregonmetro.gov/sites/default/files/2016/01/19/HB%203251-1%20overview%20501415.pdf.

[336] "Product Stewardship for Household Hazardous Waste: Stakeholder Group." Metro, www.oregonmetro.gov/stakeholders-product-stewardship-household-hazardous-waste.

[337] "Green Chemistry Definition." Environmental Protection Agency, www.epa.gov/greenchemistry/basics-green-chemistry#definition.

[338] "What is Green Chemistry?" American Chemical Society, www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry.html.

[339] "Inspired Innovation: Expanding Oregon's Advantage in Sustainable Chemistry and Materials." Oregon Environmental Council, 23 Dec. 2014, www.oeconline.org/inspired-innovation-expanding-oregons-advantage-in-sustainable-chemistry-and-materials/.

[340] "Recommendations from the Oregon Green Chemistry Advisory Group." Oregon Environmental Council, July 2010, www.oeconline.org/wp-content/uploads/2014/10/Advancing_Green_Chemistry_Report_Sept2010_web.pdf.

[341] "Fostering Environmentally-Friendly Purchasing and Product Design." Office of the Governor, State of Oregon, 27 Apr. 2012, www.oregon.gov/gov/Documents/executive_orders/eo_12-05.pdf.

[342] Manning, Rob. "Governor Signs 'Green Chemistry' Executive Order." *Oregon Public Broadcasting*, 27 Apr. 2012, www.opb.org/news/article/governor-signs-green-chemistry-executive-order/.

[343] "DEQ's Toxic Reduction Strategy." State of Oregon, www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Reducing-Toxics.aspx.

California

In 2017, SB 258 "The Cleaning Right to Know Act of 2017"[344] passed, requiring manufacturers to disclose specific ingredients in cleaning products. However, there was some lack of clarity on the language around the specific disclosures, so AB 2901 was passed in early 2018 that now includes a dictionary - "The Household and Commercial Products Association Consumer Product Ingredients Dictionary" - that must be referenced for disclosures to ensure compliance.[345] California's SB 258 was modeled after the New York Department of Environmental Conservation's Household Cleansing Product Information Disclosure Program drafted in 2016 and launched in June of 2018. These California bills were an update to an unsuccessful bill in 2016 (AB 708) that would have required manufacturers of cleaning products to list their 20 most predominant ingredients.[346] The AB 708 bill was sponsored by The Breast Cancer Fund and the Environmental Working Group,[347] and was opposed by the American Cleaning Institute and the International Fragrance Institute.

Regulatory context and action in other regions of the U.S.

New York

In 2017, New York State launched the "Household Cleansing Product Information Disclosure Program." The program was enacted under Environmental Conservation Law Article 35 and New York Code of Rules and Regulations Part 659.[348]

In 2008, New York State's Office of General Services (OGS) launched a website for New York's Green Cleaning Program.[349] It includes resources and a toolkit for facilities managers, educators and the general public with information on green cleaning.

Also proposed in 2017, but currently under committee review, are the New York State Senate Bills related to chemicals in cleaning products. They include S3870, the "Greening our Cleaning Act" requiring state agencies to purchase and use green cleaning products,[350] A3802 which would prohibit state agencies from purchasing hand soap or cleaning products containing triclosan or triclocarban and A3786 / S5053 which would prohibit the sale of cleaning products containing triclosan or triclocarban.[351]

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[344] "SB 258." California Legislative Information, 16 Oct. 2017, www.leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB258.

[345] "AB 2901 as clarification to Cleaning Products Right to Know Act." CalChamber, 15 June 2018, www.calchamberalert.com/2018/06/15/governor-signs-bill-clarifying-cleaning-product-right-to-know-act-2/.

[346] "California considers bill for chemical disclosure in cleaning products." *Chemical Watch*, 12 Jan. 2016, www.chemicalwatch.com/44470/california-considers-bill-for-chemical-disclosure-in-cleaning-products.

[347] "California Legislation Introduced to Ensure Consumer Right to Know What's In Cleaning Products." Environmental Working Group, www.ewg.org/release/california-legislation-introduced-give-consumers-right-know-what-s-their-cleaning-products#.Wt99W63MzeQ.

[348] "Household Cleansing Product Information Disclosure Program." Department of Environmental Conservation, www.dec.ny.gov/chemical/109021.html.

[349] "New York's Green Cleaning Program." *Green Cleaning New York,* www.greencleaning.ny.gov/Entry.asp.

[350] "NY State Bill 3870." New York Senate, www.legislation.nysenate.gov/pdf/bills/2017/S3870.

[351] "States in the Lead: New York." S*afer States*, www.saferstates.com/states-in-the-lead/new-york/.

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Community health risk and regulatory context of chemicals in

Furniture

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: This review primarily focuses on Polybrominated Diphenyl Ethers (PBDEs) used as flame retardants in furniture foam and upholstery. PBDEs are persistent chemicals that migrate out of furniture and into the environment. While some PBDEs have been voluntarily phased out and some have been banned through legislation, furniture manufactured prior to 2005 likely still contain the phased out or banned chemicals. Additionally, some studies suggest that the alternative chemicals are just as problematic. Elevated exposure to PBDEs has been associated with thyroid and other endocrine system disruption, adverse neurological development, reduced cognitive function, hyperactive behavior, decreased attention, diminished fine motor coordination and decreased IQ. Low-income individuals and families have higher residential exposures due to the presence of older, deteriorated or poorly manufactured furniture. Children are at higher risk of exposure than their adult counterparts because they spend more time close to the ground and touching surfaces that collect dust, followed by hand-to-mouth behavior. Black and Latinx toddlers are exposed more than White children based on variables such as age, duration of breastfeeding and socio-economic status of the family for one type of congener of PBDE. California residents face the highest PBDE exposures in the country due to TB-117, the 1975 legislation that required furniture foam to pass a flame test, and which also initiated the widespread use of PBDEs across the U.S.

Regulatory context: Several federal agencies administer regulations associated with chemicals used in furniture including the Consumer Product Safety Commission and the Environmental Protection Agency. In 2013, California released the flame test requirement of their 1975 legislation in the updated TB-117-2013, so flame retardant chemicals are no longer necessary to meet their flammability standards. Oregon passed legislation in 2005 and 2009 that bans or phases out sale of products containing pentaBDE, octaBDE and decaBDE. In 2015, the Toxic Free Kids Act established a list of high priority chemicals of concern for children's health that includes decaBDE. Washington has banned the sale of products containing PBDEs. Fifteen states have legislation regulating PBDEs and other flame retardants.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals) and non-chemical stressors (such as from racism or socioeconomic status).[352] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Low-income communities and PBDEs

Low-income individuals and families have higher residential exposures to the most harmful PBDEs. A landmark study that analyzed results from the National Health and Nutrition Examination Survey (NHANES) found that low-income individuals (<$20,000/year) had higher lipid PBDE levels compared to higher income individuals (≥$20,000/year).[353] This is thought to be due to the presence of older, deteriorated or poorly manufactured furniture in low-income residences. PBDE exposure is often linked to the purchase of outdated furniture made with materials containing foam, upholstery or other materials that contain flame retardants. Unfortunately, the longer families keep and maintain their furniture, the more prolonged overall exposure is since PBDEs do not break down quickly. In California, residents face some of the highest PBDE exposures in the country. In the 1970s, legislation intended to protect Californian consumers from fire led to very high rates of flame retardants in furniture foam.[354] Furniture manufactured between 1970 and 2013 that is still in use likely contains some form of PBDE. Californians' overall body burden is 2 to 10 times the rate for others in the U.S.,[355] and 10 times higher than those in Europe.[356]

Low-income children and children of color and PBDEs

Ingestion of PBDE-contaminated dust, to which children may be particularly susceptible, is a dominant exposure pathway. Low-income children are at higher risk of exposure than their parents or adult counterparts because they spend more time close to the ground, touching window sills, and other surfaces that collect dust, followed by increased "hand-to-mouth" behavior, thereby increasing dust intake.[357]

One study found PBDEs in the blood of all 83 North Carolina toddlers tested, but Black and Latinx toddlers had levels nearly twice as high on average as White children did. Age, duration of breastfeeding and socio-economic status of the family were correlated with one chemical congener of PBDE (BDE-153). For another PBDE (BDE 47, 99, and 100), age, gender, and level of the father's education determined serum levels. Both pentaBDE and octaBDE were phased out of use almost a decade prior (although still present in older products), suggesting that toddler exposure levels

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[352] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.
[353] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology*.
[354] Quiros-Alcala, L, et al. "Concentrations and Loadings of Polybrominated Diphenyl Ethers in Dust From Low-income Households in California." *Environment International,* Jan. 2011, www.ncbi.nlm.nih.gov/pubmed/21239062.
[355] Stapleton, H, et al. "Serum PBDEs in a North Carolina Toddler Cohort: Associations with Handwipes, House Dust, and Socioeconomic Variables." *Environmental Health Perspectives*, 23 May 2012, www.ehp.niehs.nih.gov/1104802/.
[356] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology*.
[357] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology.*

remain significant because the chemicals persist in household dust and animal products (via bioaccumulation) long after phase-out.[358]

Other factors related to socioeconomic status have been shown to contribute to PBDE exposure levels. For example, in two separate studies from California and Ohio, researchers found higher body burdens of nearly all forms of PBDE in children born to mothers without a college degree compared to those that had one. The results persisted after adjusting for age, body mass index (ie. bioacculumation), race/ethnicity, geographic site and maternal age.[359]

Based on the research, several potential pathways exist related to increased exposure to PBDEs:

- Poorer quality housing stock and furniture quality: the deterioration of PBDE-treated foam may release more compounds into the indoor air environments and depending on the ventilation systems, could be transported throughout the house and/or settle on various surfaces for ingestion through several mediums.[360]
- Poor ventilation: when there are poor ventilation systems and/or small spaces, higher concentrations of PBDE are more likely to be found. This is supported by findings showing that children living in larger houses have lower concentrations.[361]
- Dietary choices: diets high in animal products have been shown to have higher levels of PBDEs based on the bioaccumulation of chemicals in fatty tissues of animal fats or other contaminated foods.[362]

U.S. children and PBDEs

A cross national study compared PBDE levels in children and their mothers residing in either California or various study locations in Mexico. The levels found in the California cohort were higher than both the Mexican cohort and also children in six other areas of Mexico, including those living close to landfills or PDBE-producing industries. The only studied population of similar aged children with higher PDBE levels are those working and living on hazardous waste sites in Nicaragua. PBDE serum concentrations of the California cohort in the study were three times higher than those in their mothers during pregnancy, and seven times higher than those found in children of similar ages living in Mexico. Breastfeeding is a major mode of transmission of PDBE, but even the children whose mothers had been living in America for less than one year had higher levels than Mexican children, suggesting that sources of exposure were likely environmental, such as dust and food, and children's increased vulnerability due to increased hand to mouth contact.[363]

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[358] Ibid. Stapleton, H, et al. "Serum PBDEs in a North Carolina Toddler Cohort: Associations with Handwipes, House Dust, and Socioeconomic Variables." *Environmental Health Perspectives*.
[359] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology.*
[360] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology.*
[361] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology.*
[362] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology.*
[363] Betts, Kellyn S. "Children's exposure to PBDEs: binational comparison highlights dramatic differences" *Environmental Health Perspectives,* Vol. 119(10), Oct. 2011, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3230465/.

Multi-ethnic, low-income pregnant women and PBDEs

In a study looking to determine the predictors of exposure to twelve common forms of PBDE, researchers collected blood serum samples of 316 multi-ethnic, low-income pregnant women in New York City for the first six months of their pregnancies. Predictors related to demographics, diet and lifestyle were present for the congeners PBDE 47, 99, 100 and 153. All participants had at least one type of PBDE detected in their serum, and depending on other characteristics related to SES, diet and lifestyle, the concentrations varied. Women with higher levels of education combined with higher use of household electronics resulted in higher amounts of all four specific types of congeners. PBDE 153 was most common amongst study participants and was associated with "maternal education, household income, body mass index, solid dairy consumption, processed meat consumption and frequent use of household electronics."[364]

College dormitory residents and flame retardants

In a study of furniture in college dormitories, very high levels of flame retardants were found in dust samples. Two congeners - DecaBDE, a flame retardant that was largely phased out in 2013, and PentaBDE, which was phased out in 2005 - were found at levels nine times and four times higher than ever previously recorded respectively. These high levels of exposure are likely because dorms are several small, relatively confined spaces that contain a lot of (often old) furniture and electronics[365] and recirculate shared air.

Lower-income newborns, infants and breastfeeding children and PBDEs

PBDEs have been associated with thyroid and other endocrine system disruption and adverse neurological development.

> "Given that PBDEs exposures may be higher among lower income populations and have the ability to disrupt the thyroid system, future studies should evaluate the impact of these exposures on thyroid-mediated health endpoints, such as preterm birth and hypertension, where there is a persistence of SES health disparities. Additionally, animal studies should examine potential interactions between PBDEs and other stressors which may be elevated in vulnerable populations to avoid underestimating potential health risks and to better account for background susceptibility due to environmental and non environmental stressors."[366]

PBDEs, lower IQ and hyperactivity

In utero exposure to PBDEs has been associated with child cognitive function and behavior in the literature. For example, one study that tracked 309 women from 16 weeks gestation through their child's 5th year found that while the overall mean of maternal serum levels of BDE-47, a specific PBDE congener, was equivalent to the national average levels, it resulted in changes to their child's cognitive and behavioral development by 5 years of age. Its presence was associated with a "4.5-

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[364] Horton, MK, et al. "Predictors of Serum Concentrations of Polybrominated Flame Retardants among Healthy Pregnant Women in an Urban Environment: A Cross-sectional Study." *Environmental Health*, 8 Mar. 2013, www.ncbi.nlm.nih.gov/pubmed/23497089.

[365] Dodson, Robin, et al. "Flame Retardant Chemicals in College Dormitories: Flammability Standards Influence Dust Concentrations." *Environmental Science and Technology*, 13 Apr. 2017, www.pubs.acs.org/doi/abs/10.1021/acs.est.7b00429.

[366] Ibid. Zota, Ami R. "Are PBDEs an Environmental Equity Concern?" *Environmental Science and Technology.*

point decrease (95 percent CI: -8.8, -0.1) in Full-Scale IQ and a 3.3-point increase (95 percent CI: 0.3, 6.3) in the hyperactivity score at age 5 years."[367]

In a longitudinal cohort of 329 mothers in Manhattan, blood cord specimens were examined for PBDE congeners and related development effects from 12 to 28 and at 72 months. Children with higher levels of several PBDEs had lower scores on the 12-month Psychomotor Development Index (BDE-47), 24-month Mental Development Index (MDI) (BDE-47, 99, and 100), 36-month MDI (BDE-100), 48-month full-scale and verbal IQ (BDE-47, 99, and 100) and performance IQ (BDE-100), and 72-month performance IQ (BDE-100).[368]

In a study of 601 women in California and their children, in utero and childhood PBDE exposure were associated with decreased attention, diminished fine motor coordination, and decreased Verbal and Full-Scale IQ at 7 years. This study was the largest of its kind to date, drawing strong connections between PBDE exposure and negative cognitive development.[369]

Federal regulatory context

Several federal agencies administer regulations associated with chemicals used in furniture. The most relevant is the Consumer Product Safety Commission (CPSC) - some regulations concern flammability of upholstered furniture, lead-containing surface coatings and children's furniture. In the cases of formaldehyde-containing wood, regulation is managed by the Environmental Protection Agency (EPA) under the Toxic Substances Control Act (TSCA) which establishes limits for formaldehyde emissions from composite wood products: hardwood plywood, medium-density fiberboard, and particleboard (see detail under *Building materials*). For products with antimicrobial textiles, manufacturers must comply with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (see detail under *Apparel and outdoor wear*).[370]

The Consumer Product Safety Act (CPSA) was first introduced in 1972. The legislation was designed to protect the public against unreasonable risks associated with consumer products, develop uniform safety standards for products, and study and prevent product-related illnesses and injuries. The act created the Consumer Product Safety Commission (CPSC), an independent federal regulatory agency authorized to require cautionary labeling of hazardous household products that might cause personal injury or illness as a result of reasonably foreseeable handling, use or ingestion. Hazardous substances may be banned or regulated where labels alone fail to provide sufficient protection and products intended for children may be banned for containing hazardous chemicals.

The CPSC has jurisdiction over more than 15,000 types of consumer products used in and around the home, in recreation and in schools, from children's toys to portable gas generators and toasters.

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[367] Ibid. Chen, A, et al. "Prenatal Polybrominated Diphenyl Ether Exposures…" *Environmental Health Perspectives*.
[368] Herbstman, JB, et al. "Prenatal Exposure to PBDEs and Neurodevelopment." *Environmental Health Perspectives,* 4 Jan. 2010, www.ehp.niehs.nih.gov/0901340/.
[369] Eskenazi, B, et al. "In Utero and Childhood Polybrominated Diphenyl Ether (PBDE) Exposures and Neurodevelopment in the CHAMACOS Study." *Environmental Health Perspectives,* 15 Nov. 2012, www.ehp.niehs.nih.gov/1205597/.
[370] "A Guide to United States Furniture Compliance Requirements." National Institute of Standards and Technology, 12 Apr. 2016, www.cpsc.gov/s3fs-public/04.12.2016%20Guide%20to%20US%20Furniture%20Requirements.pdf.

However, large segments of the 15,000 products are excluded because they are under the jurisdiction of other federal statutes.

The CPSA requires manufacturers or distributors of consumer products to immediately report to the CPSC when they obtain information which reasonably supports the conclusion that a product contains a defect which could create a substantial product hazard, or creates an unreasonable risk of serious injury or death. A "substantial product hazard" is defined as a product defect which creates a substantial risk of injury to the public.

The CSPC issues voluntary and mandatory standards, but primarily relies on industry associations to offer and negotiate standards that address product labeling, recall/repair of products, research on hazards and distribution of consumer safety information. CPSC selects a product hazard for review based on public petitions, referrals from other agencies, congressional requests or staff initiatives.

Current rules for furniture products require third party testing and children's certificate for lead containing products, bassinets, cradles, bedside sleepers, cribs, toddler beds and bunk beds.[371]

In 2005, the EPA issued a Significant New Use Rule (SNUR)[372] that dictated supply chain communication around the use of PBDEs whereby the EPA would evaluate their use prior to manufacturing and distribution.[373]

Western U.S. regulatory context and local action

Oregon

In 2005, SB 962[374] was adopted which bans toxic flame retardants pentaBDE and octaBDE. It also recommended banning decaBDE. In 2009, Oregon adopted SB 596[375] which phases out toxic flame retardant decaBDE from products bought and sold in the state. In 2015 the Toxic Free Kids Act (SB 478 and HB 3473)[376] was adopted thus establishing a list of high priority chemicals of concern for children's health (HPCCCH) that includes decaBDE, and authorizes the participation in the Interstate Chemicals Clearinghouse (IC2). The Toxic Free Kids Act also authorizes the Oregon Health Authority to ban or grant waivers for the sale of certain products containing HPCCCHs.

California

In 1975 California passed TB 117, requiring all upholstered furniture sold in the state to contain flame-retardant chemicals. The regulation dictated that cover fabric should withstand a one-second small flame test and the internal upholstery foam a 12-second test.[377] In response to California's

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[371] Ibid. "A Guide to United States Furniture..." National Institute of Standards and Technology.
[372] "Polybrominated Diphenylethers (PBDEs) Significant New Use Rules (SNUR)." Environmental Protection Agency, www.epa.gov/assessing-and-managing-chemicals-under-tsca/polybrominated-diphenylethers-pbdes-significant-new-use.
[373] "Polybrominated Diphenyl Ethers (PBDEs) Action Plan." Environmental Protection Agency, 2009, www.epa.gov/sites/production/files/2015-09/documents/pbdes_ap_2009_1230_final.pdf.
[374] "SB962." Oregon Legislative Assembly, 2005, www.ncel.net/articles/OR-SB962.2005.pdf.
[375] "SB 596." Oregon Legislative Information, www.olis.leg.state.or.us/liz/2009R1/Measures/Overview/SB596.
[376] "SB 478 / HB 3473." Oregon Legislative Information, www.olis.leg.state.or.us/liz/2015R1/Measures/Overview/SB478.
[377] "Technical Bulletin 117- Residential Upholstered Furniture Standard Fact Sheet." Bureau of Electronic and Appliance Repair, Home Furnishings, and Thermal Insulation, www.bearhfti.ca.gov/industry/tb_117_faq_sheet.pdf.

legislation, flame retardants became common additives in furniture manufacturing across the country.[378]

Due to numerous studies linking PBDEs to health problems, the only domestic chemical manufacturer of PBDE products, Great Lakes Chemical, began a voluntary phase out of PBDE use in flame retardants in 2003 which completed at years end in 2004.[379] A 2012 study conducted by the Green Science Policy Institute and Dr. Heather Stapleton[380] and Duke University found that between 1984 and 2010, 85 percent of couches still contained harmful chemicals.[381] Additionally, in 2012 The Chicago Tribune[382] ran an award-winning series on the harm and faulty science around the effectiveness of flame retardants which ultimately led to California's reassessment of fire safety standards in furniture (as directed by the Governor).[383] As a result, TB 117-2013 was implemented in 2013 to allow manufacturers to maintain fire safety without toxic chemicals (covering materials were still required to be flame resistant, but the internal upholstery was not).[384] [385]

From 2006 to 2009, the chemical production industry mounted a $23 million (and ultimately unsuccessful) effort to keep the old standards in place.[386] Chemtura, a major manufacturer of flame-retardant chemicals, sued California over the new standards in 2014.[387] The lawsuit was dismissed, and TB 117-2013 remains legal. Still, a new standard is not a ban. If manufacturers choose, they can continue to make upholstered furniture using flame-retardant chemicals. Thus, in 2014 the California Legislature passed SB 1019 requiring appropriate labeling of furniture using chemical flame retardants.[388]

Washington

In 2004, Governor Gary Locke directed the Washington State Department of Ecology and the Department of Health to investigate the threat of PBDEs which found high levels of PBDEs in dust and food in homes.[389] As such, the legislature passed RCW 70.76 banning the sale of products

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[378] "Flame Retardants in Furniture." Green Science Policy Institute, www.greensciencepolicy.org/topics/furniture/.
[379] Tullo, Alex. "Great Lakes To Phase Out Flame Retardants." Chemical and Engineering News, 2003, www.pubs.acs.org/doi/abs/10.1021/cen-v081n045.p013a.
[380] Stapleton, Heather, et al. "Novel and High Volume Use Flame Retardants in U.S. Couches Reflective of the 2005 PentaBDE Phase Out." *Environmental Science & Technology*, Jan. 2014, www.greensciencepolicy.org/wp-content/uploads/2014/01/38-Stapleton-Sharma-2012.pdf.
[381] Ibid. Stapleton, Heather, et al. "Novel and High Volume Use Flame Retardants..." *Environmental Science & Technology.*
[382] MacDonald, Sherry. "Chemical Companies, Big Tobacco and the Toxic Products in Your Home." *Chicago Tribune*, 30 Dec. 2012, www.media.apps.chicagotribune.com/flames/index.html.
[383] Westervelt, Amy. "California Law Change Sparks Nationwide Demand for Flame-Retardant-Free Furniture." *The Guardian*, 30 Sep. 2014, www.theguardian.com/sustainable-business/2014/sep/30/healthcare-flame-retardants-gb117-california-steelcase-knoll-herman-miller-kaiser.
[384] Ibid. "Polybrominated Diphenylethers (PBDEs) Significant New Use Rules (SNUR)." Environmental Protection Agency.
[385] "TB117-2013." Home Furnishings Association, www.myhfa.org/tb117-2013/.
[386] Zissu, Alexandra. "The Fight Against Flame Retardants." *NRDC*, 18 Jan. 2016, www.nrdc.org/stories/fight-against-flame-retardants.
[387] Hawthorne, Michael. "Chemical industry fights for flame retardants." *Chicago Tribune,* 29 Aug. 2014, www.chicagotribune.com/news/watchdog/ct-flame-retardants-furniture-met-20140828-story.html.
[388] "Senate Bill No. 1019." California Legislative Information, 30 Sep. 2014, www.leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1019.
[389] "Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan." Department of Ecology, 19 Jan. 2006, www.fortress.wa.gov/ecy/publications/documents/0507048.pdf.

containing PBDEs.[390][391] Before this was enacted the Departments of Ecology and Health were directed to investigate safer alternatives and a report was published in January 2009.[392] As a result, the ban on PBDE products was effective January 1, 2011.[393]

In 2015, The Washington State Department of Ecology released a report (as directed by the state legislature in 2014) with details on health effects from flame retardants.[394] This report led to an amendment to the Children's Safe Product Act thus banning five flame retardant chemical materials from children's products and residential furniture.[395] The Department of Ecology was also directed to investigate the effects of six other chemical materials.

Regulatory context and action in other regions of the U.S.

Several states have legislation regulating PBDEs and other flame retardants (AK, CA, CT, IN, IA, MD, MA, MN, NH, NJ, NY, TN, VA, WV, OR). Much of this action has stemmed from California legislation.[396]

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[390] "Chapter 70.76 RCW." Washington State Legislature, www.apps.leg.wa.gov/rcw/default.aspx?cite=70.76&full=true.
[391] "What are PBDEs?" Washington State Department of Health, www.doh.wa.gov/CommunityandEnvironment/Contaminants/PBDEs.
[392] "Alternatives to Deca-BDE in Televisions and Computers and Residential Upholstered Furniture." Washington State Department of Ecology, Jan. 2009, www.fortress.wa.gov/ecy/publications/summarypages/0907041.html.
[393] Ibid. "What are PBDEs?" Washington State Department of Health.
[394] "Flame Retardants - A Report to the Legislature." Washington State Department of Ecology, Dec. 2014, www.fortress.wa.gov/ecy/publications/SummaryPages/1404047.html.
[395] "Flame Retardant." Washington State Department of Ecology, www.ecology.wa.gov/Waste-Toxics/Reducing-toxic-chemicals/Addressing-priority-toxic-chemicals/PBDE.
[396] "Toxic Flame Retardants." Safer States, Jan. 2019, http://www.saferstates.com/toxic-chemicals/toxic-flame-retardants/.

Community health risk and regulatory context of chemicals in

Personal care products

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: Personal care products contain an array of chemicals, many of them not tested for health impacts because of regulatory gaps. This summary focuses primarily on phthalates with additional, yet limited information on exposure and impacts related to formaldehyde, bisphenol compounds (BPA, BPS and BPF), mercury and triclosan. Women and female adolescents in general and communities of color may experience higher exposure to chemicals of concern from use of personal care products. In addition, due to systemic racism, sexism, and capitalism, women in general are told that their worth is dependent on their physical beauty as a marketing strategy to drive the sales of beauty products. This is heightened for women of color as they are also told that whiteness is the standard of beauty, which acts to drive the sales of skin lighteners and hair straighteners. Fetuses are exposed in utero as many chemicals can cross the placental wall. Prenatal phthalate exposure - not necessarily specifically from personal care products - has been linked to many male reproductive abnormalities, including smaller genitals and incomplete descent of the testicles. Infants are also vulnerable due to the widespread use of phthalates and bisphenol compounds in infant toys, lotions and powders. Small and developing children exposed are more likely to develop motor delays, certain behavior problems, early menarche, stunted growth and neurological and cognitive delays.

Regulatory context: Federal regulation has had limited success in testing, and regulating the production, use and labeling of chemicals of concern in personal care products. When products are regulated, it is primarily under the Federal Food, Drug, and Cosmetic Act administered by the Food and Drug Administration. State legislation has been enacted, including Oregon's Toxic Free Kids Act, Washington's Children's Safe Product Act and California's Safer Consumer Products Program that includes some personal care products.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals)

and non-chemical stressors (such as from racism or socioeconomic status).[397] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Latina, African-American, female adolescents and phthalates

Exposure to phthalates is associated with the use of personal care products. In a youth-led study in California, 100 Latina girls saw significant decreases in urinary phthalates, parabens and triclosan after they changed the use of personal care products to those that had labels specifically stating they lacked those chemicals.[398]

A study of 20 women ages 14 to 19 discovered an average of 16 chemicals from 4 chemical families in their bodies, including phthalates and triclosan. Because teen women use a higher average number of personal care products than adult women, they are disproportionately exposed to the products' health impacts, including endocrine disruption.[399]

Use of hair oil and perm in young African American women has been linked to earlier menarche, potentially due to the endocrine disrupting chemicals present in these personal care products.[400]

Evidence exists suggesting phthalates also have thyroid-disrupting properties. For example, a study of Danish children aged 4 to 9 showed a correlation among higher concentrations of urinary phthalate concentration and shorter child height. This association was found for both girls and boys.[401]

Infants and fetuses and phthalates

In a study that looked at 9 types of phthalates commonly found in infant products, such as lotions, powders and shampoos, 7 were above the "limit of detection" in 81 percent of the infants (n=163). Urine samples were collected within 24 hours of the product being used and the concentration as well as number of different chemicals of concern increased with the number of products used. The younger the infant, the stronger the association due to their under- and still developing metabolic system and their small surface area (i.e., small bodies in proportion to their exposure). Overall, infants are more vulnerable to impacts of exposure based on their immature developmental and reproductive systems.[402]

Even though phthalates pass through the body relatively quickly,[403] their ubiquity in products used daily resulted in a positive presence screening in 85 to 100 percent of a test group of 246 pregnant

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[397] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[398] Ibid. Harley, KG, et al. "Reducing Phthalate, Paraben, and Phenol Exposure from Personal Care Products in Adolescent Girls: Findings from the HERMOSA Intervention Study."

[399] "Teen Girl's Body Burden of Hormone-Altering Cosmetics: Detailed Findings." Environmental Working Group, 24 Sep. 2008, www.ewg.org/research/teen-girls-body-burden-hormone-altering-cosmetics-chemicals/detailed-findings#.Wty-NNPwYfF.

[400] Childhood Hair Product Use and Earlier Age at Menarche in a Racially Diverse Study Population: A Pilot Study, HHS Author Manuscripts, Jul. 30 2014, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4116338/.

[401] Ibid. Boas, M, et al. "Childhood Exposure to Phthalates: Associations with Thyroid Function, Insulin-like Growth Factor I, and Growth."

[402] Ibid. Sathyanarayana, S., et al. "Baby Care Products: Possible Sources of Infant Phthalate Exposure."

[403] Ibid. Genuis, Stephen, et al. "Human Elimination of Phthalate Compounds: Blood, Urine, and Sweat (BUS) Study."

Dominican and African-American women.[404] Once exposed, placental transfer of these chemicals can occur through the blood to a developing fetus.[405]

Although legislation and industry pressure over the past decade has likely resulted in decreased presence of some DEHP - one type of phthalate - they are replaced with other types - DiNP and DiDP - that have a similar level of concern.[406,407]

In a study examining the effects of prenatal phthalate exposure on cognitive development, three-year olds with elevated phthalate exposure were more likely to develop motor delays, certain behavior problems and decreased mental development.[408] Prenatal phthalate exposure has also been linked to many male reproductive abnormalities, including smaller genitals and incomplete descent of the testicles.[409]

Women of color and phthalates

Because much of media depicts whiteness as a beauty ideal in America, some women of color are disproportionately more exposed to the toxics present in skin lighteners and hair straighteners. For example, "African American consumers purchase 9 times more ethnic hair and beauty products than other groups, and disproportionately purchase hair relaxers and straighteners. Latinos are the fastest growing ethnic beauty market segment, and Asian Americans spend 70 percent more than the national average on skin care products."[410]

Studies have found that African American women experience higher exposures to phthalates from personal care products than white women,[411] that African-American and African-Caribbean women are more likely than white women to use hair products such as hair oil, lotion, leave-in conditioner, root stimulator and perm that contain chemicals that are endocrine disruptors. [412] A larger number of African American women than White and Mexican American women report frequently using

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[404] Ibid. Adibi, JJ, et al. "Characterization of Phthalate Exposure among Pregnant Women Assessed by Repeat Air and Urine Samples."

[405] Ibid. Mose, T, et al. "Phthalate Monoesters in Perfusate From a Dual Placenta Perfusion System, the Placenta Tissue and Umbilical Cord Blood."

[406] Ibid. Zota, AR, Calafat AM, and TJ Woodruff. "Temporal Trends in Phthalate Exposures: Findings from the National Health and Nutrition Examination Survey."

[407] Ibid. "Evaluation of New Scientific Evidence Concerning DINP and DIDP." European Chemicals Association.

[408] Ibid. Whyatt, RM, et al. "Maternal Prenatal Urinary Phthalate Metabolite Concentrations and Child Mental, Psychomotor, and Behavioral Development at 3 Years of Age."

[409] Ibid. Kim, Y, et al. "Prenatal Exposure to Phthalates and Infant Development at 6 Months: Prospective Mothers and Children's Environmental Health (MOCEH) Study."

[410] Zota, AR, and B Shamasunder. "The Environmental Injustice of Beauty: Framing Chemical Exposures From Beauty Products as a Health Disparities Concern." *American Journal of Obstetrics and Gynecology*, Oct. 2017, www.ajog.org/article/S0002-9378(17)30862-1/fulltext.

[411] Varshavsky, JR, Zota, AR, and TJ Woodruff. "'A Novel Method for Calculating Potency-Weighted Cumulative Phthalates Exposure with Implications for Identifying Racial/Ethnic Disparities among U.S. Reproductive-Aged Women in NHANES 2001–2012." *Environmental Science and Technology,* 31 Aug. 2016, www.pubs.acs.org/doi/full/10.1021/acs.est.6b00522.

[412] James-Todd, T, Senie, R, and MB Terry. "Racial/Ethnic Differences in Hormonally-Active Hair Product Use: A Plausible Risk Factor for Health Disparities." *Journal of Immigrant and Minority Health*. 31 May 2011, www.link.springer.com/article/10.1007%2Fs10903-011-9482-5.

vaginal douches, feminine spray and feminine powder, resulting in 48 percent higher levels of the phthalate MEP.[413]

Endocrine disruption in all populations and phthalates

The presence of the phthalate metabolite MEHP has been associated with increased pregnancy loss,[414] and exposure to diethyl phthalate has been associated with increased likelihood of breast cancer.[415] Elevated urinary metabolites of phthalates have been associated with decreased testosterone in men, women and children.[416] A weak correlation exists between phthalate exposure and incidences of endometriosis.[417]

Men and triclosan

In a study of 315 men under the age of 40, triclosan was present in the urine of 84 percent of the participants. A positive association was found between urinary concentrations of triclosan in the 50th to 75th percentile and abnormal sperm morphology, suggesting a correlation between triclosan and male infertility.[418]

Elders and BPA

Associations were found between BPA and phthalates exposure with LDL cholesterol, diastolic blood pressure and fasting glucose in an elderly study population.[419]

People of color and mercury

Mercury is present in many skin-lightening creams, which have become especially popular in African countries like Ghana, Nigeria, Mali, Kenya and Tanzania,[420] as well as in India, the Middle East and Southeast Asia. Neuropsychiatric symptoms were reported by women in Arizona exposed to mercury in cosmetic cream,[421] and many other cases of mercury poisoning (including kidney and nervous system damage) have been attributed to skin-lightening products.[422] New York City

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[413] Branch, F, et al. "Vaginal Douching and Racial/ethnic Disparities in Phthalates Exposures Among Reproductive-aged Women: National Health and Nutrition Examination Survey 2001–2004." *Journal of Immigrant and Minority Health*, 31 May 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC4502470/.

[414] Toft, G, et al. "Association between Pregnancy Loss and Urinary Phthalate Levels around the Time of Conception." *Environmental Health Perspectives,* 23 Nov. 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC3295336/.

[415] Carrillo-Lopez, L, et al. "Exposure to Phthalates and Breast Cancer Risk in Northern Mexico." *Environmental Health Perspectives*, 9 Dec. 2009, www.ncbi.nlm.nih.gov/pmc/articles/PMC2854732/.

[416] Meeker, JD, and KK Ferguson. "Urinary Phthalate Metabolites are Associated with Decreased Serum Testosterone in Men, Women, and Children from NHANES 2011-2012." *Journal of Clinical Endocrinology and Metabolism*, 14 Aug. 2014, www.ncbi.nlm.nih.gov/pmc/articles/PMC4223430/.

[417] Reddy, BS, et al. "High plasma Concentrations of Polychlorinated Biphenyls and Phthalate Esters in Women with Endometriosis: A Prospective Case Control Study." *Fertility and Sterility*, Mar. 2006, www.ncbi.nlm.nih.gov/pubmed/16500362.

[418] Jurewicz, J, et al. "Environmental Levels of Triclosan and Male Fertility." *Environmental Science and Pollution Research*, Feb. 2018, www.link.springer.com/article/10.1007%2Fs11356-017-0866-5.

[419] Olsen, L, Lind, L, and PM Lind. "Associations Between Circulating Levels of Bisphenol A and Phthalate Metabolites and Coronary Risk in the Elderly." *Ecotoxicology and Environmental Safety,* 1 June 2012, www.sciencedirect.com/science/article/pii/S0147651312000632?via%3Dihub.

[420] Agorku, Eric S, et al. "Mercury and Hydroquinone Content of Skin Toning Creams and Cosmetic Soaps, and the Potential Risks to the Health of Ghanaian Women. *Springerplus*, 11 Mar. 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC4788657/.

[421] McRill, C, et al. "Mercury Toxicity due to Use of a Cosmetic Cream." *Journal of Occupational and Environmental Medicine*, Jan. 2000, www.journals.lww.com/joem/Abstract/2000/01000/Mercury_Toxicity_due_to_Use_of_a_Cosmetic_Cream.4.aspx.

[422] Chan, TY. "Inorganic Mercury Poisoning Associated with Skin-lightening Cosmetic Products." *Clinical Toxicology*, Dec. 2011, www.ncbi.nlm.nih.gov/pubmed/22070559?dopt=Abstract.

recently issued a health advisory in reference to several skin-lightening creams and soaps with elevated mercury levels.[423]

African American men, low-income Individuals, and youth and BPA

Overall, "younger individuals, men, and non-Hispanic blacks were more likely to have high levels of BPA. Non-Hispanic blacks and individuals with lower family income and levels of education were more likely to have elevated levels of BPS than those with higher family income or education levels. No significant differences of population characteristics were found for BPF."[424] In a study of the impact of bisphenol compounds (BPA, BPF and BPS) on 1,521 adults, BPA exposure was associated with general and abdominal obesity. However, no association was found between BPF and BPS and obesity.

White women and formaldehyde

The impacts of formaldehyde exposure range from skin irritation and hair loss to cancer. For example, the Brazilian Blowout hair smoothing treatment was censured by the FDA after OSHA investigations showed that formaldehyde was present in the product despite its claim to be "formaldehyde free[425]" and independent lab tests showed formaldehyde levels of 11.5 percent.[426]

Female hairdressers and several chemicals

Ninety-five percent of hairstylists and 85 percent of personal appearance workers are female. Thirty-two percent are African American, Asian, and Latinx. Chemicals of concern in the hairstyling industry include: formaldehyde, methyl methacrylate, p-phenylenediamine and ammonium persulfate, as well as toluene, ammonia and methyl methacrylate, which are often found in the air of the salons.[427,428] Women in this industry face health risks from exposures that include skin conditions, respiratory conditions, reproductive disorders and birth defects,[429] cancer, depression, Alzheimer's Disease and other neurotoxic effects, immune disorders and heart disease. Critical issues for this sector are long-term, intergenerational impacts of reproductive disorders and birth defects.[430,431,432]

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[423] "2018 Health Advisory #6." New York City Department of Health and Mental Health, 27 Mar. 2018, www.nyc.gov/assets/doh/downloads/pdf/han/advisory/2018/advisory-6-skin-lightening-creams.pdf.

[424] Liu, B, et al. "Bisphenol A Substitutes and Obesity in U.S. Adults: Analysis of a Population-based, Cross-sectional Study." *The Lancet Planetary Health*, June 2017, www.sciencedirect.com/science/article/pii/S2542519617300499.

[425] "Hazard Alert Update." United States Department of Labor, Sep. 2011, www.osha.gov/SLTC/formaldehyde/hazard_alert.html.

[426] Pierce, JS, et al. "Characterization of Formaldehyde Exposure Resulting from the Use of Four Professional Hair Straightening Products." *Journal of Occupational and Environmental Hygiene*, 28 Oct. 2011, www.tandfonline.com/doi/abs/10.1080/15459624.2011.626259.

[427] "Beauty and Its Beast." *Women's Voices for the Earth*, Nov. 2014, www.womensvoices.org/safe-salons/beauty-and-its-beast/.

[428] Pak, VM, Powers, M. and J. Liu."Occupational Chemical Exposures Among Cosmetologists, Risk of Reproductive Disorders." *Workplace Health and Safety*, 9 Dec. 2014, www.ncbi.nlm.nih.gov/pmc/articles/PMC4260452/.

[429] Halliday-Bell, JA, Gissler, M. and JJ Jaakkola. "Work as a Hairdresser and Cosmetologist and Adverse Pregnancy Outcomes." *Journal of Occupational Medicine*, May 2009, www.ncbi.nlm.nih.gov/pubmed/19270042.

[430] Ibid. Halliday-Bell, JA, Gissler, M. and JJ Jaakkola. "Work as a Hairdresser..." *Journal of Occupational Medicine.*

[431] Harling, M, et al. "Bladder Cancer Among Hairdressers: A Meta-analysis." *Occupational and Environmental Medicine*, May 2010, www.ncbi.nlm.nih.gov/pubmed/20447989/.

[432] Gan, Vicky. "The Fight to Rid Black Women's Hair Salons of Toxic Chemicals." *City Lab*, 6 Nov. 2015, www.citylab.com/life/2015/11/the-fight-to-rid-black-womens-hair-salons-of-toxic-chemicals/414430/.

Urban populations and use of volatile chemical products

A 2018 study found that the use of volatile chemical products (VCPs)—including pesticides, coatings, cleaning agents, printing inks, adhesives and personal care products—now constitutes half of fossil fuel VOC emissions in industrialized cities in the U.S., and exceeds that from vehicle fuel emissions.[433]

Federal regulatory context

The Federal Food, Drug, and Cosmetic Act (FFDCA) was first authorized in 1938 and then significantly updated in 1997. The FFDCA requires premarket approval of new drugs, food additives, and coloring agents and authorizes standards for levels of pesticides, naturally occurring poisons, and toxic additives in or on food products. In addition, the law establishes standards for chemical content in various products and defines departures from those standards as adulteration or misbranding.

The FFDCA is administered by the Food and Drug Administration (FDA). The FDA sets the standards for manufacturer-mandated testing and data on drug effectiveness and safety. For prescription drugs, the agency sets the conditions determining production processes, product labeling, product advertising and managing special uses. For over the counter drugs, the FDA sets standards for acceptable ingredients, doses, formulations and labeling. Chemical additives to foods, drugs or cosmetics are considered adulterations unless specifically approved based on the evidence of safety submitted by the manufacturer. In making such approvals, the agency may specify conditions of use, the amount of a chemical substance in a product and any required product labeling.

The FDA's Center for Drug Evaluation and Research (CDER) regulates over-the-counter (OTC) and prescription drugs, including biological therapeutics and generic drugs covered by the FFDCA. The FFDCA covers more than just medicines. For example, fluoride toothpaste, antiperspirants, dandruff shampoos and sunscreens are all considered drugs.[434] There are more than 80 therapeutic categories of OTC drugs, "articles intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease." Drugs (broadly defined) must generally either receive pre-market approval by FDA through the New Drug Application (NDA) process or conform to a "monograph" for a particular drug category, as established by FDA's Over-the-Counter (OTC) Drug Review. These monographs specify conditions whereby OTC drug ingredients are generally recognized as safe and effective, and not misbranded.[435]

Although the word "cosmetic" is used in the title of the FFDCA law, cosmetics are not subject to FDA regulations in the way foods and drugs are and the FDA has little authority over the safety of cosmetics, other than approving color additives before products go to market. Cosmetic manufacturers may use any ingredient unless the FDA proves it may be harmful. The FFDCA law prohibits, under interstate commerce, the marketing of adulterated or misbranded cosmetics which

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[433] Ibid. "Volatile chemical products emerging as largest petrochemical source of urban organic emissions." *Science*.
[434] "About the Center for Drug Evaluation and Research." U.S. FDA, 19 Sep 2018, https://www.fda.gov/AboutFDA/CentersOffices/OfficeofMedicalProductsandTobacco/CDER/default.htm.
[435] "Is It a Cosmetic, a Drug, or Both? (Or Is It Soap?)." U.S. Food & Drug Administration, www.fda.gov/Cosmetics/GuidanceRegulation/LawsRegulations/ucm074201.htm.

includes containing poisonous substances or false labeling.[436] Under FFDCA, the FDA is not authorized to require cosmetic manufacturers to register their products or the chemical ingredients in their products, and it cannot require them to substantiate product safety or performance claims. "Review" of cosmetic product is conducted by an industry trade association and registration of cosmetics and fragrances (of particular concern) is voluntary, so few participate.

The FDA's Office of Cosmetics and Colors monitors cosmetics on the market to ensure that they are safe for consumers. The FDA becomes aware of safety issues during inspections of manufacturing and distribution facilities and when a voluntary adverse event report (AER) is filed by a consumer, manufacturer or health care professional. In this context, an adverse event could be any problem experienced when using a cosmetic product.

Lack of safety substantiation for cosmetics is a primary criticism of FFDCA. Another policy limitation is that cosmetic manufacturers are not required to register their facilities with the agency, or follow what are known as Good Manufacturing Practices (GMPs) to ensure adherence to quality standards. Additionally, unlike certain other regulated products, including food and dietary supplements, the FDA cannot require companies to recall products if problems are identified.[437]

The Personal Care Products Safety Act (PCPSA), in committee

This bipartisan bill (S. 1113) was first introduced in 2015 by Senators Dianne Feinstein (D-CA) and Susan Collins (R-ME) to provide considerably more oversight of personal care products by the FDA and is presently in committee.[438] Since introduction, it has continued to evolve and the senators are working with various stakeholders (such as Beautycounter, the American Pediatrics Association, Endocrine Society and March of Dimes)[439] to hone the language. In its current form, the bill would do the following (adapted from Beautycounter story about the bill[440] and a Viewpoint contribution in the Journal of the American Medical Association JAMA Internal Medicine by Feinstein and Collins in February 2018):[441]

- Require the FDA to review at least five chemicals per year based on input from consumers, medical professionals, scientists and companies.
- Require companies to share ingredient information with the FDA.
- Require companies to report "serious adverse events" related to their products within 15 days of the event.

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[436] FDA Authority Over Cosmetics: How Cosmetics Are Not FDA-Approved, but Are FDA-Regulated, U.S. Food and Drug Administration, https://www.fda.gov/cosmetics/guidanceregulation/lawsregulations/ucm074162.htm#What_does_the_law.
[437] "Using Adverse Event Reports to Monitor Cosmetic Safety." U.S. Food & Drug Administration, 3 Nov. 2017, www.fda.gov/cosmetics/complianceenforcement/adverseeventreporting/ucm531634.htm.
[438] "Personal Care Products Safety Act (S.1113) Summary." Environmental Working Group, www.cdn3.ewg.org/sites/default/files/u352/Personal%20Care%20Products%20Safety%20Act%20%28S.1113%29%20Summary%20.pdf?_ga=2.267703758.1194070990.1524589355-115566080.1524243846.
[439] "Beautycounter Description of PCPSA." Beautycounter, 17 Nov. 2017, https://blog.beautycounter.com/beautycounter-endorses-personal-care-product-safety-act/.
[440] Ibid. "Beautycounter Description of PCPSA." Beautycounter.
[441] Feinstein, Dianne and Susan Collins. "Viewpoint: The Personal Care Products Safety Act." *JAMA Internal Medicine*, 5 Feb. 2017, www.feinstein.senate.gov/public/index.cfm/op-eds?ID=CFFA2261-11AE-4A11-A3BA-971B514BA40B.

- Allow the FDA to recall unsafe personal care products (e.g. hair straightening products with formaldehyde).
- Provide protections for small businesses while maintaining public health.
- Ensure adequate funding for FDA for oversight and staffing.

The goal is to provide a uniform safety standard. Companies may choose to adhere to stricter guidelines than the FDA imposes.

The PCPSA bill has been refined and was officially introduced on May 11, 2017. The bill remains in the first stage of the legislative process and will be considered in the Senate Health, Education, Labor and Pensions Committee. The Skopos Labs[442] prediction forecasts only a 3 percent chance the bill will pass.[443]

Other than the above legislation, the EPA has a Safer Choice program which appears to be geared more towards education than policy.[444]

Western U.S. regulatory context and local action

Oregon

Green chemistry initiatives

"Green chemistry" is a concept taking root in Oregon. Green chemistry initiatives could encourage product developers to design healthier and more sustainable products.[445]

The American Chemical Society describes this as:

> "Sustainable and green chemistry… is just a different way of thinking about how chemistry and chemical engineering can be done. Over the years different principles have been proposed that can be used when thinking about the design, development and implementation of chemical products and processes. These principles enable scientists and engineers to protect and benefit the economy, people and the planet by finding creative and innovative ways to reduce waste, conserve energy, and discover replacements for hazardous substances."[446]

The Oregon Environmental Council (OEC) hopes to poise Oregon as a national leader in sustainable chemistry and materials.[447] The OEC convened The Oregon Green Chemistry Advisory Group in 2009 to develop recommendations to advance green chemistry in Oregon.[448] Members included Oregon Department of Environmental Quality (DEQ), Oregon Business Development Department, Oregon Manufacturing Extension Partnership, University of Oregon, Portland State University, and

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[442] "Home Page." Skopos Labs, www.skoposlabs.com.
[443] "S.1113: Personal Care Products Safety Act." GovTrack, 11 May 2017, www.govtrack.us/congress/bills/115/s1113.
[444] "Safer Choice." EPA, www.epa.gov/saferchoice.
[445] Ibid. "What is Green Chemistry." American Chemical Society.
[446] "Green Chemistry Definition." American Chemical Society, www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry/definition.html.
[447] Ibid. "Inspired Innovation: Expanding Oregon's Advantage..." Oregon Environmental Council.
[448] Ibid. "Recommendations from the Oregon Green Chemistry Advisory Group." Oregon Environmental Council.

business leaders from Nike, Inc., Blount International, Inc., and Coastwide Laboratories. DEQ also published those recommendations in 2010.[449]

In 2012, Governor Kitzhaber signed Executive Order No. 12-05, "Fostering Environmentally-Friendly Purchasing and Product Design,"[450] which is described as a "green chemistry executive order."[451] DEQ describes actions resulting from that as leveraging state purchasing power to encourage innovation.[452] In 2014, The Center for Sustainable Materials Chemistry, a collaboration between Oregon State University and the University of Oregon, won a $20 Million grant from the National Science Foundation to fund their work on green and sustainable chemistry.[453]

Toxic-Free Kids Act

The Oregon Toxic-Free Kids Act of 2015 that requires manufacturers to report products containing high priority chemicals of concern for children's health does include children's personal care products, including cosmetics.[454,455] Under ORS 431A.253, those products containing High Priority Chemicals of Concern for Children's Health above the determined thresholds must be reported.[456] The law also requires manufacturers to remove these chemicals from certain products or seek a waiver. This law is based largely on Washington's Children's Safe Product Act, using the same original list of priority chemicals.

California

California launched the Safer Consumer Products (SCP) Program[457] in 2013, a green chemistry initiative with a goal to reduce the toxic chemical exposure from everyday product use and to participate in promoting the development and technology around greener products. The process the program takes includes the following[458]:

1. SCP identifies which chemicals pose health or environmental hazards.
2. SCP identifies the products that contain the chemicals. These are called "Priority Products."[459]
3. The companies that make Priority Products will evaluate their use of hazardous chemicals in their products by using the Alternative Analysis process, which involves examining safer alternatives to chemicals of concern.[460]

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[449] "Green Chemistry Resources." State of Oregon, www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Green-Chemistry-Resources.aspx.
[450] Ibid. "Fostering Environmentally-Friendly Purchasing and Product Design." Office of the Governor, State of Oregon.
[451] "US State of Oregon Sees Green Chemistry Executive Order." *Chemical Watch*, www.chemicalwatch.com/10964/us-state-of-oregon-sees-green-chemistry-executive-order.
[452] Ibid. "DEQ's Toxic Reduction Strategy." State of Oregon.
[453] Williams, Christina. "Oregon Green Chemistry Center Wins $20M Grant." *Portland Business Journal*, 8 Sep. 2011, www.bizjournals.com/portland/blog/sbo/2011/09/oregon-green-chemistry-center-wins.html.
[454] Ibid. "High Priority Chemicals of Concern for Children." Oregon Health Authority.
[455] Ibid. "ORS 431A.250." Oregon Legislature.
[456] Ibid. "ORS 431A.253." Oregon Legislature.
[457] Ibid. "Safer Consumer Products Program." California Department of Toxic Substances Control.
[458] Ibid. Singla, Veena. "New California program is on a Mission to Reduce Toxic Chemicals in our Everyday Products."
[459] Ibid. "What is a Priority Product?" California Department of Toxic Substances Control.
[460] Ibid. Singla, Veena. "Selecting Safer Alternatives To Toxic Chemicals And Ensuring The Protection Of The Most Vulnerable: A Discussion."

4. SCP issues a regulatory response.
5. Companies make adjustments to the products based on the regulatory response requirements.[461]

In 2015, California Bill AB 888 was adopted to ban plastic microbeads from personal care products.[462]

Regulatory context and action in other regions of the U.S., and internationally

European Union and Canada

Europe and Canada are leading the way in banning chemicals from beauty products that are still allowed in products in the United States. In 2003, the E.U. adopted The E.U. Cosmetics Directive,[463] amended in 2013, which bans 1,328 chemicals from cosmetic products.[464] Health Canada (Canada's federal health department) regularly reviews cosmetic products and prohibits certain chemicals (see their Chemical Ingredient "Hotlist").[465]

Advocacy organizations and companies

Safer personal care products are a focus for several nonprofits and companies including Campaign for Safe Cosmetics, BeautyCounter, Safer Chemicals Healthy Families, Environmental Working Group and their Skin Deep Cosmetics Database, and others. Below is additional information on two of these.

Campaign for Safe Cosmetics,[466] a project of Breast Cancer Prevention Partners (formerly the Breast Cancer Fund), conducts education, advocacy and legislative campaigns to help eliminate dangerous chemicals from cosmetic products.

BeautyCounter[467] is a beauty product company launched specifically focused on providing safe cosmetic products to customers. Beyond selling products, they're actively engaged in advocacy work[468] and speak regularly about the harmful effects of toxic chemicals in everyday products. They recently endorsed the PCPSA bill (see above) and are serving as a leader in the cosmetics industry to help drive legislative change.[469]

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[461] Ibid. "Final 2018-2020 Priority Product Work Plan." California Department of Toxic Substances Control.
[462] "Assembly Bill No. 888." California Legislative Information, 8 Oct. 2015, www.leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB888.
[463] "EU Cosmetics Directive 1." Eur-Lex, Nov. 2009, www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009R1223.
[464] "International Laws." Campaign for Safe Cosmetics, July 2013, www.safecosmetics.org/get-the-facts/regulations/international-laws/.
[465] Ibid. "International Laws." Campaign for Safe Cosmetics.
[466] "Home Page." Campaign for Safe Cosmetics, www.safecosmetics.org.
[467] "Home Page." Beautycounter, www.beautycounter.com.
[468] "Advocacy." Beautycounter, www.beautycounter.com/advocacy.
[469] Krause, Rachel. "This Law Could Change The Beauty Industry In A Huge Way." *Refinery29*, 17 Nov. 2017, www.refinery29.com/2017/11/181592/beautycounter-cosmetics-safety-regulations?bucketed=true&bucketing_referrer=https%3A%2F%2Fwww.google.com%2F.

Community health risk and regulatory context of

Single use food and drink containers

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: Plastic and chemicals from food contact materials are prolific in our food and environment - they have been found in sea mammals and aquatic life, our food and water supply, and in packaged and fast foods. Styrenes, phthalates, bisphenols, and perfluoroalkyl and polyfluoroalkyl substances (PFAS), all of which are reviewed here, can be leached from plastic and other food and beverage storage containers. Exposures may also result from food handling gloves, packaging and processing equipment as well as non-food contact material sources. Urinary analysis in human studies has found widespread exposure. Phthalates have been detected in 98 percent of the U.S. population at large. BPA has been detected in 90 percent of the U.S. population. Studies suggest that high rates of consumption of predominantly shelf stable, packaged food increases exposure levels. One recent analysis of known health risks indicates that at least 175 of commonly used food packaging chemicals are either known or suspected endocrine disruptors, or exhibit carcinogenic, mutagenic or reproductive toxicity. In addition, many chemicals used in food packaging are linked to other health impacts, such as cardiac toxicity, liver damage, low birth weight, pulmonary effects such as asthma, impairment of neurological development in the fetal and infant brain, and thyroid dysfunction. Research suggests low income communities, people of color and children experience heightened risks or exposure from chemicals that may be found in food contact materials.

Regulatory context: The Food and Drug Administration under the Federal Food, Drug, and Cosmetic Act regulates food contact substances such as resins, coatings, pigments and adhesives in food packaging as "indirect food additives" that are largely not required to be disclosed on labels. If manufacturers report that substances will be below established thresholds, are generally recognized as safe, or were in use in food prior to 1958, requirements for premarket notification with safety data are exempted. A Pew Charitable Trust report found that a large percent of additives - including those from food contact materials - have not been reviewed for safety by the FDA. California and Washington state each have legislation banning - under certain circumstances - the production and use of PFAS for food packaging.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals) and non-chemical stressors (such as from racism or socioeconomic status).[470] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Overview of chemicals of concern in food contact materials

Food contact substances (FCS), which are chemicals in food contact materials (FCMs) have long posed a challenge to researchers concerned with human health, nutrition and the environment. FCMs are articles used in packaging, food storage, processing or preparation equipment that comes directly into contact with human foods such as fast food packaging wrappers, cups and paper. Most often, FCMs are made of plastic or have a synthetic material in direct contact with the foodstuff. Importantly, most FCMs are not inert. Chemicals contained in the FCM, such as monomers, additives, processing aids or reaction by-products, can diffuse into foods.[471]

Primary chemicals of concern in food and drink containers and packaging include:

- Bisphenol A (BPA), and other bisphenols (e.g. BPS and BPF) found in polycarbonate plastics, and the epoxy resin linings of metal cans
- Phthalates used as plasticizers in PVC food packaging found in the cling film for meat, fish, cheese and vegetables
- 4-nonylphenol, a secondary compound produced from the degradation of the antioxidant and thermal stabilizer tris (nonylphenyl) phosphite (TNPP) found in some rubber products and PVC food wraps
- Di (2-ethylhexyl) adipate (DEHA), a non-phthalate plasticizer and potential carcinogen used in meat wrapping operations
- Diisononyl phthalate (DiNP)
- Perfluorinated chemicals (PFCs), also known as Per- and polyfluoroalkyl substances (PFAS), such as perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), and perfluoroalkyl acids (PFAAs), include 11 pervasive chemicals used, among many things, to coat greaseproof paper and treat paper and fiber containers.
- Styrene, a building block and breakdown product of polystyrene and polystyrene foam
- Perchlorate, used in various formulations for food packaging gasket closures (aka zip lock) and as an antistatic agent in dry food packaging.

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[470] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[471] Muncke, Jane, et al. "Food Packaging and Migration of Food Contact Materials: Will Epidemiologists Rise to the Neotoxic Challenge?" *Journal of Epidemiology & Community Health*, July 2014, www.jech.bmj.com/content/68/7/592.

Product formulations of FCMs vary widely. The total number of known chemical substances used intentionally in FCMs exceeds 4,000 and the upper end of the range found exceeds 6,500.[472]

Public interest concerns about adverse health effects are driving changes. For example, in recent years, long-chain PFASs have been replaced by short-chain PFASs, notably leading to new food contact paper called GenX. These alternative chemicals have shorter human half-lives than their long-chain counterparts, are less bio-accumulative, but persist in the environment and are harder to remove from drinking water. Very little information about human half-lives and potential health effects of other replacement PFASs is available, despite widespread exposures and documented toxicity of related long-chain PFASs.[473] Retired EPA toxicologist and senior risk assessor Deborah Rice commented that GenX has "the same constellation of [health] effects you see with PFOA. There's no way you can call this a safe substitute."[474]

In 2008, the Environmental Working Group (EWG) reviewed the FDA safety assessments and approvals and concluded that in approving four PFC alternatives, the agency failed to adequately consider the long-term health consequences from exposure. FDA has since approved 20 additional PFC chemicals and added them to the Inventory of Effective Food Contact Substances, a database of materials approved to come into contact with food.[475]

The scientific community notes that though the chemical toxicology of PFCs is generally well understood, the long-term impacts from low-level exposure are not well documented. And it is unlikely that many epidemiological and clinical studies suggested by concerned scientists would be carried out, mainly because they are too costly and there is limited funding from the federal government or other sources to support this.[476]

Recent early stage research finds that compared to virgin materials, recycled materials demonstrate higher human toxicity potential through packaged food consumption. This puts attention on circular economy efforts including recycling and post-consumer waste markets.[477] There are opportunities for Metro in this area, particularly in light of current federal policy changes concerning "legitimate recycling" covered by the Resource Conservation and Recovery Act (RCRA).[478]

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[472] "Exposure to Chemicals in Food Packaging as a Sustainability Trade-off in LCA." 10th International Conference on Life Cycle Assessment of Food, 2016, www.orbit.dtu.dk/files/126841856/Ernstoff_2016c.pdf.
[473] Schaider, Laurel, et al. "Fluorinated Compounds in U.S. Fast Food Packaging." *Environmental Science & Technology Letters*, Feb. 2017, www.pubs.acs.org/doi/full/10.1021/acs.estlett.6b00435?src=recsys.
[474] "New Teflon Toxin Causes Cancer In Lab Animals." *The Intercept,* 3 Mar. 2016, www.theintercept.com/2016/03/03/new-teflon-toxin-causes-cancer-in-lab-animals/.
[475] Ibid. "Poisoned Legacy: Where Consumers Encounter PFCs Today." Environmental Working Group.
[476] "Scientists Warn of Chemical Dangers in Food Packaging, but not without their Critics." *The Conversation*, 19 Feb. 2014, www.theconversation.com/scientists-warn-of-chemical-dangers-in-food-packaging-but-not-without-their-critics-23446.
[477] Ibid. "Exposure to Chemicals in Food Packaging..." 10th International Conference on Life Cycle Assessment of Food.
[478] "Final Rule: 2018 Definition of Solid Waste (DSW) Response to Court Vacatur." Environmental Protection Agency website, 2018. https://www.epa.gov/hw/final-rule-2018-definition-solid-waste-dsw-response-court-vacatur.

General population and endocrine disruption

In the US, nearly 75 percent of daily purchased food calories come from packaged food and drinks.[479] The endocrine effects of PFCs, BPA and other bisphenols, phthalates, styrene and other chemicals in food packaging are of particular concern. Toxicology protocols and safety assessments adhere to the doctrine that the "dose makes the poison." They assume that hazards increase linearly from lower to higher doses, and they extrapolate low-dose effects from high-dose studies. For endocrine disruptors, this assumption is inaccurate. Hormonally active agents can exert their effects at very low doses - often in ways that are functionally different from effects associated with high doses - and they can display non-linear dose-response curves. The inaccurate dose-response curves compromise both exposure assessments, which set the floors for regulatory action, and safety assessments, which are predicated on high-dose studies. Regulators routinely establish default levels of exposure to chemicals below which no, or minimal effects are expected, but these are regulatory conveniences that do not necessarily correspond to actual risk."[480] The European Food Safety Authority (EFSA) published its comprehensive re-evaluation of BPA exposure and toxicity, in January 2015 when it reduced the Tolerable Daily Intake for BPA from 50 to 4 µg/kg bw/day.[481]

General population and PFAS

Scientists from nonprofit research organizations, federal and state regulatory agencies and academic institutions collaborated to test samples of sandwich and pastry wrappers, french fry bags, pizza boxes, and other paper and paperboard from 27 fast food chains and several local restaurants in five regions of the U.S. They found that of the 327 samples used to serve food, collected in 2014 and 2015, 40 percent tested positive for fluorine, indicating the presence of PFCs.[482] PFCs can migrate to food most readily via oil and emulsifying agents,[483] meaning the grease-resistant properties of the FCMs are most often used for the food substances where PFC exposure pathways are highest.

People who eat packaged or processed foods are likely to be chronically exposed to low levels of toxins from food contact materials (FCMs) throughout their lives. Precautionary scientists reporting in the British Medical Journal argue that "Since most foods are packaged, and the entire population is likely to be exposed, it is of utmost importance that gaps in knowledge are reliably and rapidly filled." Potential cellular changes caused by chemicals in FCMs, and in particular, those with the capacity to disrupt hormones, are not even being considered in routine toxicology analysis, which prompts scientists to cast serious doubts on the adequacy of chemical regulatory

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[479] Boseley, Sarah. "UK Eats Almost Four Times More Packaged Food than Fresh." *The Guardian,* 7 Apr. 2017, www.theguardian.com/society/2017/apr/07/uk-eats-almost-four-times-more-packaged-food-than-fresh.

[480] "What's in the Package? Unveiling the Toxic Secrets of Food and Beverage Packaging." Clean Water Action and Clean Water Fund, Aug. 2016, www.cleanwateraction.org/sites/default/files/CA_TIP_rpt_08.24.16a_web.pdf.

[481] "Bisphenol A." European Food Safety Administration, www.efsa.europa.eu/en/topics/topic/bisphenol.

[482] "Many Fast Food Wrappers Still Coated in PFCs, Kin to Carcinogenic Teflon Chemical." Environmental Working Group, 1 Jan. 2017, www.ewg.org/research/many-fast-food-wrappers-still-coated-pfcs-kin-carcinogenic-teflon-chemical#.WvNTEtMvzOQ.

[483] Begley, TH, et al. "Migration of Fluorochemical Paper Additives from Food-Contact Paper into Foods and Food Simulants." Food Additives Contamination Part A, Mar. 2008, www.ncbi.nlm.nih.gov/pubmed/18311629.

procedures.[484] The market value of packaged food in the U.S. grew from $354 to $377 billion from 2013 to 2017.[485]

Americans of all incomes eat fast food regularly, but contrary to myth, those earning less than $30,000 per year actually are 10 percent less likely to eat fast food weekly.[486] Another nationwide study of baby boomers shows that fast food consumption is not concentrated among the poor, but distributed relatively equally by income. Convenience appears to be the key reason behind heavy users of fast food.[487] The food-package combination can lead to large variations in the extent of exposure to chemicals through packaging use.[488]

The half-life for these chemicals in the human body ranges from two to more than eight years, with animals showing significantly longer processing times for males compared to females.[489] PFCs are being studied by the National Toxicology Program (NTP) because of their widespread exposure to humans, persistence in the environment, observed toxicity in animal models, and insufficient information to make claims about human health risk.[490]

New research by the Minnesota Department of Health has found that "The accumulation of some PFAS in women of childbearing age, and the placental and breastmilk transfer to their offspring, require new risk assessment methods to protect public health… Even short exposures during infancy have dramatic impacts on serum levels for many years. In addition, developmental effects are the critical effects anchoring recent risk assessments... Peak breastfed infant serum levels were 4.4-fold higher than in formula-fed infants, with both of these scenarios producing serum levels in excess of the adult steady-state level."[491] Department of Health staff involved in the study were careful to point out that these findings do not suggest that concerns about PFAS in breastmilk outweigh the benefits of breastfeeding, which is itself a health equity issue.

The extent of migration of chemicals from packaging to food depends upon the amount and type of PFASs used, contact time and temperature with food. It is difficult to assess exposure and risk associated with PFASs in fast food packaging because the extent of exposure from FCMs and the toxicity of most fluorinated chemicals in FCMs are poorly characterized.[492] However, a Canadian study comparing intakes of perfluoro carboxylates (PFCAs) and PFOS via other routes (air, water,

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[484] Ibid. Muncke, J, et al. "Food Packaging Chemicals May be Harmful to Human Health over Long Term." *British Medical Journal*.

[485] "Market Value of Packaged Food in the United States from 2013 to 2018." *Statista*, 2018, www.statista.com/statistics/491685/packaged-food-united-states-market-value/.

[486] Dugan, Andrew. "Fast Food Still Major Part of U.S. Diet." *Gallup*, Aug. 2013, www.news.gallup.com/poll/163868/fast-food-major-part-diet.aspx.

[487] Zagorsky, JL and PK Smith. "The Association between Socioeconomic Status and Adult Fast-food Consumption in the U.S." *Economics & Human Biology*, 19 Apr. 2017, www.ncbi.nlm.nih.gov/pubmed/28472714.

[488] Ibid. "Exposure to Chemicals in Food Packaging..." 10th International Conference on Life Cycle Assessment of Food.

[489] "Long-Chain Perfluorinated Chemicals (PFCs) Action Plan." Environmental Protection Agency, Dec. 2009, www.epa.gov/sites/production/files/2016-01/documents/pfcs_action_plan1230_09.pdf.

[490] Ibid. "Perfluorinated Chemicals (PFCs)." National Institute of Environmental Health Sciences.

[491] Ibid. "A transgenerational toxicokinetic model." *Journal of Exposure Science & Environmental Epidemiology*.

[492] Muncke, J, et al. "Food Packaging Chemicals May be Harmful to Human Health over Long Term." *British Medical Journal*. 10 Feb. 2014, www.sciencedaily.com/releases/2014/02/140219205215.htm.

dust, treated carpeting and apparel) suggested that diet is an important source of these compounds.[493]

General population and BPA

BPA has been in production since the 1960s and is found in polycarbonate plastics, which are often used in containers that store food and beverages, such as reusable and disposable water bottles and caps. BPA is also used to create epoxy resins to coat the inside of metal products, such as food cans, bottle tops and water supply lines. Some dental sealants and composites also may contain BPA.[494,495]

Research shows that BPA can seep into food or beverages. BPA is a potential endocrine disruptor. BPA within the normal range of human exposure suppresses levels of adiponectin - a protein hormone which is involved in regulating glucose levels as well as fatty acid breakdown - and may thus directly increase risks of developing metabolic syndrome and associated conditions, including contributing to higher rates of obesity.[496,497] It could also impact reproductive development, neurodevelopment, cause mammary and prostate cancer, and have an overall impact on fetuses, infants and children.[498,499,500] Additional research suggests a possible link between BPA and increased blood pressure.[501]

Following the controversy on the safety of BPA and the subsequent banning of BPA in 11 states[502] and manufacturer production changes for baby and infant products,[503] BPS (2,2-bis [4-hydroxyphenol]sulfone) and BPF (2,2-bis [4-hydroxyphenol]methane) were introduced as a chemical replacement in many plastic products. They are currently unregulated.[504] BPS has been detected in everyday products such as personal care products, paper products, food and indoor dust, and in urine samples.[505] Thermal receipt paper is also a source of occupational exposure to

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[493] Tittlemier, SA et al. "Dietary Exposure of Canadians to Perfluorinated Carboxylates and Perfluorooctane Sulfonate via Consumption of Meat, Fish, Fast Foods, and Food Items Prepared in Their Packaging." J*ournal of Agricultural and Food Chemistry*, 24 Mar. 2007, www.pubs.acs.org/doi/abs/10.1021/jf0634045.

[494] "What is BPA? And What are the Concerns of BPA?" Mayo Clinic, www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/expert-answers/bpa/faq-20058331.

[495] "Bisphenol A (BPA) Factsheet." Centers for Disease Control and Prevention, National Biomonitoring Program, 7 Apr. 2017, https://www.cdc.gov/biomonitoring/BisphenolA_FactSheet.html.

[496] Hugo, ER, et al. "Bisphenol A at Environmentally Relevant Doses Inhibits Adiponectin Release from Human Adipose Tissue Explants and Adipocytes." Environmental Health Perspectives, 14 Aug. 2008, www.ncbi.nlm.nih.gov/pmc/articles/PMC2599757/.

[497] "Safety of Bisphenol A (BPA) in Food & Beverage Packaging." The Association of Food, Beverage and Consumer Products Companies, www.gmaonline.org/downloads/wygwam/NR_BPA_SO.pdf.

[498] Ibid. "What is BPA? And What are the Concerns of BPA?" Mayo Clinic.

[499] Ibid. Nelson, JW, et al. "Social Disparities in Exposures…" Environmental Health.

[500] Nelson, JW, et al. "Social Disparities in Exposures to Bisphenol A and Polyfluoroalkyl Chemicals: A cross-sectional study within NHANES 2003-2006. *Environmental Health*, 6 Mar. 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC3312862/.

[501] Ibid. "What is BPA? And What are the Concerns of BPA?" Mayo Clinic.

[502] "State Laws on BPA." *Consumer Reports*, 14 Aug. 2012, https://advocacy.consumerreports.org/research/progress-in-protecting-our-children/.

[503] "Bisphenol A (BPA): Use in Food Contact Application." U.S. Food and Drug Administration, June 2018, https://www.fda.gov/newsevents/publichealthfocus/ucm064437.htm.

[504] Ibid. Vina, R., and CS Watson. "Bisphenol S Disrupts Estradiol-Induced Nongenomic Signaling in a Rat Pituitary Cell Line: Effects on Cell Functions."

[505] Ibid. Rochester, JR. and AL. Bolden. "Bisphenol S and F: A Systematic Review and Comparison of the Hormonal Activity of Bisphenol A Substitutes."

BPS[506] (see *Workplace exposures in the service sector*). However, "based on the current literature, BPS and BPF are equally hormonally active as BPA, and they also have endocrine-disrupting effects. For example, "BPF was found to have potencies in the same order of magnitude as BPA in regard to androgenic, antiandrogenic, antiestrogenic, and aryl hydrocarbon activity and inhibitory hormonal signaling in adipocytes."[507]

Low-income populations and BPA

BPA is present in food packaging, which may pose a disproportionate health risk to already vulnerable and health stressed populations. Food insecure households, such as recipients of the Supplemental Nutrition Assistance Program (SNAP), are less likely than non-participants and food-secure households to drive their own vehicle, meaning less frequent trips to the store and more packaged food. When consumers shop less frequently, choosing non-perishable foods is important."[508] National and local studies across the U.S. suggest that residents of low-income, minority and rural neighborhoods are most often affected by poor access to supermarkets and healthful, fresh food.[509] The USDA defines food deserts as "parts of the country vapid of fresh fruit, vegetables, and other healthful whole foods, usually found in impoverished areas. This is largely due to a lack of grocery stores, farmers' markets, and healthy food providers."[510]

In a study that looked at socioeconomic positions - family income, education, occupation and food security combined with their associations with race/ethnicity - family income was the single strongest predictor of levels of accumulated toxics in bodies. People with lower incomes had higher body burdens of BPA and the reverse was true for PFCs. BPA concentrations were highest in people who reported very low food security and received emergency food assistance.[511] Greater reliance on packaged food - whether for financial reasons, limited accessibility or both - would be expected to lead to higher body burdens of food packaging chemicals.

Two separate studies of National Health and Nutrition Examination Survey (NHANES) populations[512] found that lower-income participants had significantly higher urinary levels of BPA than did those with higher incomes.[513] This was especially true in families with 6 to 11 year olds that accessed emergency food - they had levels 54 percent higher than children of families that didn't receive emergency food.[514]

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[506] Ibid. Thayer, KA, et al. "Bisphenol A, Bisphenol S, and 4-Hydroxyphenyl 4-Isoprooxyphenylsulfone (BPSIP) in Urine and Blood of Cashiers."
[507] Ibid. Rochester, JR. and AL. Bolden. "Bisphenol S and F: A Systematic Review..." *Environmental Health Perspectives.*
[508] "Most U.S. Households Do Their Main Grocery Shopping at Supermarkets and Supercenters Regardless of Income." U.S. Department of Agriculture, 3 Aug. 2015, www.ers.usda.gov/amber-waves/2015/august/most-us-households-do-their-main-grocery-shopping-at-supermarkets-and-supercenters-regardless-of-income./.
[509] "Neighborhood Environments: Disparities in Access to Healthy Foods in the U.S." U.S. Department of Agriculture, 3 Aug. 2015, www.ncbi.nlm.nih.gov/pubmed/18977112.
[510] "USDA Defines Food Deserts." American Nutrition Association, www.americannutritionassociation.org/newsletter/usda-defines-food-deserts.
[511] Ibid. Nelson, JW, et al. "Social disparities in exposures to bisphenol A and polyfluoroalkyl chemicals: a cross-sectional study within NHANES 2003-2006."
[512] "Details About the CDC Cohort." Center of Disease Control and Prevention, www.cdc.gov/nchs/nhanes/about_nhanes.htm.
[513] Ibid. Nelson, JW, et al. "Social Disparities in Exposures…" *Environmental Health*.
[514] Ibid. Nelson, JW, et al. "Social Disparities in Exposures…" *Environmental Health*.

People of color and BPA

While BPA was found in 90 percent of the overall U.S. population, even higher levels of exposure were found for non-Hispanic blacks, children, females and those of lower socioeconomic status.[515] One study found BPA in 9 out of 10 cord blood samples from babies of African American, Asian and Hispanic descent.[516] Mexican Americans had the lowest levels of any racial/ethnic group even when adjusting for income levels. One hypothesis is that Hispanics tend to eat more fresh fruits and vegetables as seen in several national surveys. This could displace packaged food consumption at levels seen in other race/ethnicities.[517]

Children and BPA

BPA intake is higher in small children and infants from hand-to-mouth and "direct oral (mouth) contact" with products (teethers, containers, etc.) that contain BPA.[518] Exposure levels for women of childbearing age and for children are concerning because of increased vulnerability and the potential impact on the developing systems.[519]

General population and phthalates

Phthalate exposure is widespread, with "98 percent of the U.S. general population having detectable levels of DEHP and DiNP in urine samples and even higher exposures observed in children."[520] Phthalates readily migrate out of packaging because they are not chemically bound to the PVC polymer, and dissolve upon contact of food wrap with liquids or fats such as from meat, fish and cheese commonly packaged for sale in groceries. Since phthalates bind with fats, they tend to build up in fatty foods, including not just cheese but baked goods, infant formula, meats, oils and fats, and fast food.[521] Phthalates, along with lead, are also found in coffee brewed from single serve coffee containers.[522] Phthalate studies in animals found reproductive abnormalities and developmental effects as well as adverse effects on the lungs, liver and kidneys. Human health impact studies have identified a possible association between exposure to phthalates and male reproductive malformation, sperm damage, fertility impairment, female reproductive tract diseases, early puberty in girls, asthma and thyroid effects.[523]

One source of chemical exposure to phthalates in food is through disposable poly vinyl chloride (PVC) gloves, which are widely made with plasticizers to make them flexible enough to stretch onto

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[515] Zota, AR, Phillips, CA, and SD Mitro. "Recent Fast Food Consumption and Bisphenol A and Phthalates Exposures among the U.S. Population in NHANES, 2003–2010." *Environmental Health Perspectives*, 13 Apr. 2016, www.ehp.niehs.nih.gov/15-10803/.
[516] "Toxic Chemicals Found in Minority Cord Blood." Environmental Working Group, 2 Dec. 2009, www.ewg.org/news/news-releases/2009/12/02/toxic-chemicals-found-minority-cord-blood#.WvPbxNMvzOQ.
[517] Ibid. Nelson, JW, et al."Social Disparities in Exposures…" *Environmental Health*.
[518] Ibid. "Bisphenol A (BPA) Factsheet." Centers for Disease Control and Prevention.
[519] Lakind, JS and DQ Naiman. "Bisphenol A (BPA) Daily Intakes in the United States: Estimates from the 2003-2004 NHANES Urinary BPA Data." *Journal of Exposure Science & Environmental Epidemiology*, Nov. 2008, www.ncbi.nlm.nih.gov/pubmed/18414515.
[520] Ibid. Zota, AR, Phillips, CA, and SD Mitro. "Recent Fast Food Consumption and Bisphenol A..." *Environmental Health Perspectives*.
[521] Rabin, Roni Caryn. "Phthalates Found in Powdered Mac-and-Cheese Mixes." *Seattle Times*, 13 Jul. 2017, www.seattletimes.com/nation-world/whats-in-your-childs-mac-and-cheese-toxic-chemicals-a-new-study-says/.
[522] De Toni, Luca, et al. "Phthalates and Heavy Metals as Endocrine Disruptors in Food: A Study on Pre-Packed Coffee Products." *Toxicology Reports*, Feb. 2017, www.sciencedirect.com/science/article/pii/S2214750017300264.
[523] "Phthalates and Their Alternatives: Health and Environmental Concerns." Lowell Center for Sustainable Production Technical Briefing, Jan. 2011, www.ec.europa.eu/environment/aarhus/pdf/35/Annex_11_report_from_Lowell_Center.pdf.

hands. These plasticizers are often made of BPA and/or phthalates DiNP and DEHP,[524] which exposes both the food handler through dermal contact and leaches into foods and food products.

PVC pipes are another source of contamination in food. For example, one study found high levels of DEHP in baby foods due to the PVC tube that was used in production and transport of food into baby food containers.[525] Another study found contamination and high levels of DEHP in several processed food products and attributed it to its use in "food contact materials" such as gloves and tubing used in the processing facilities.[526]

One study that examined associations between dietary exposures and urinary chemical concentrations of phthalates (and BPA, though results showed no / low association for BPA) of 8,877 participants from the National Health and Nutrition Examination Survey (NHANES 2003-2010) found a positive exposure-response relationship with fast food intake and phthalate exposure. Participants with high consumption of fast food had between 23.8 to 39 percent higher levels of DEHP and DiNP than non-fast food consumers.[527]

Fetuses, infants and children and PFAS, phthalates

PFAS

Exposure to PFAS from fast food packaging is especially relevant for children, because one-third of U.S. children consume fast food daily, and children may be more susceptible to adverse health effects.[528] The CDC reports that from 2011 to 2012, children and adolescents aged 2 to 19 years old consumed an average 12.4 percent of their daily calories from fast food.[529] Elevated exposures to PFCs are associated with reduced humoral immune response to routine childhood immunizations in children aged 5 and 7 years.[530]

Phthalates

In its 2012 Phthalate Action Plan, the EPA highlighted the "toxicity and the evidence of pervasive human and environmental exposure" of phthalates, particularly for infants and children.[531] A recent scientific review concluding that dairy products were the greatest source of dietary exposure to the phthalate DEHP for infants and women of reproductive age. This prompted tests by the Coalition for Safer Food Processing and Packaging that found phthalate concentrations in powder from

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[524] "Vinyl Gloves - Protection or Poison?" *Eagle Protect*, 9 Nov. 2017, www.blog.eagleprotect.com/vinyl-gloves-protection-or-poison.

[525] Tsumara, Y, et al. "Eleven Phthalate Esters and Di(2-ethylhexyl) Adipate in One-Week Duplicate Diet Samples Obtained from Hospitals and their Estimated Daily Intake." *Food Additives and Contaminants*, May 2001, www.ncbi.nlm.nih.gov/pubmed/11358187.

[526] Hai-Xia, Sui, et al. "Concentration of Di(2-ethylhexyl) Phthalate (DEHP) in Foods and its Dietary Exposure in China." *International Journal of Hygiene and Environmental Health,* Jul. 2014, www.sciencedirect.com/science/article/pii/S1438463914000182.

[527] Ibid. Zota, AR, Phillips, CA, and SD Mitro. "Recent Fast Food Consumption and Bisphenol A..." *Environmental Health Perspectives*.

[528] Ibid. Schaider, Laurel, et al. "Fluorinated Compounds in U.S. Fast Food Packaging."

[529] "Caloric Intake From Fast Food Among Children and Adolescents in the United States, 2011–2012." Center for Disease Control, Sep. 2015, www.cdc.gov/nchs/data/databriefs/db213.htm.

[530] Grandjean, Phillipe, et al. "Serum Vaccine Antibody Concentrations in Children Exposed to Perfluorinated Compounds." *JAMA*, 25 Jan. 2012, www.jamanetwork.com/journals/jama/fullarticle/1104903.

[531] Ibid. "What's in the Package?" Clean Water Action and Clean Water Fund.

macaroni and cheese mixes were more than four times higher than in block cheese and other natural cheeses, for example shredded, string and cottage cheese.[532]

According to the U.S. Consumer Product Safety Commission up to 725,000 American women of childbearing age may be exposed daily to phthalates at levels that threaten the healthy development of their babies, should they be pregnant.[533] There is strong evidence that phthalates block the production of the hormone testosterone in the developing male fetus. Emerging research suggests links between early childhood exposure to phthalates and neurodevelopmental and behavior problems in young children, including aggression, hyperactivity and possible cognitive delays.[534]

General population and styrene exposure

Styrene is a building block and breakdown product of polystyrene and polystyrene foam. Polystyrene is used in several consumer products that require some type of insulation, including food packaging to keep food and drinks fresher, warmer or cooler longer; packaging to protect against damage such as egg cartons or meat/poultry trays; and in the walls to insulate refrigerators and freezers and cold storage facilities.[535] In 1985, styrene was in the top 10 synthetic organic compounds produced at 3.8 million tons.[536]

The styrene monomer from polystyrene disposable cups becomes most mobile when in contact with high heat and high fat beverages, such as coffee, cocoa and espresso drinks,[537] take away soups/soup cups,[538] and yogurt and cheese containers/packaging.[539] Also vulnerable to heat are plastic storage containers, which break down over time and use and begin to release monomers into the food. BPA, dioxins and phthalates have all been found to leach into food, especially when the plastic is in contact with heated or hot foods.[540] Styrene was also detected in water stored in bottles, though at lower levels than other high fat and/or heat products.[541]

Styrene is considered a potential endocrine disruptor and carcinogen, though as of 2014, more research is needed to better identify the health implications of styrene exposures.[542,543] Recent

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[532] "Testing Finds Industrial Chemical Phthalates in Cheese." *Klean Up Kraft*, http://kleanupkraft.org/data-summary.pdf.
[533] Carlson, Kent and Wioletta Szeszel-Fedorowicz. "Estimated Phthalate Exposure and Risk to Women of Reproductive Age as Assessed Using 2013/2014 NHANES Biomonitoring Data." U.S. CPSC, Feb. 2017, www.cpsc.gov/s3fs-public/Estimated%20Phthalate%20Exposure%20and%20Risk%20to%20Women%20of%20Reproductive%20Age%20as%20Assessed%20Using%202013%202014%20NHANES%20Biomonitoring%20Data.pdf.
[534] Ibid. Rabin, Roni Caryn. "Phthalates Found in Powdered Mac-and-cheese Mixes." *Seattle Times*.
[535] "Polystyrene." *Chemical Safety Facts*, www.chemicalsafetyfacts.org/polystyrene-post/#content.
[536] Bond, James and Hermann Bolt. "Review of The Toxicology of Styrene." *CRC Critical Reviews in Toxicology*, 26 Sep. 2008, www.tandfonline.com/doi/abs/10.3109/10408448909037472?src=recsys.
[537] Mohammad-Reza, K and M Ghazi-Khansari. "Determination of Migration Monomer Styrene from GPPS (general purpose polystyrene) and HIPS (high impact polystyrene) Cups to Hot Drinks." *Toxicology Mechanisms and Methods,* 1 Mar. 2009, www.tandfonline.com/doi/abs/10.1080/15376510802510299.
[538] Tawfik, MS, and A Huyghebaert. "Polystyrene Cups and Containers: Styrene Migration." *Food Additives & Contaminants,* www.tandfonline.com/doi/abs/10.1080/02652039809374686.
[539] Ibid. Tawfik, MS, and A Huyghebaert. "Polystyrene Cups and Containers..." *Food Additives & Contaminants.*
[540] Athair, SS. "Using Plastic Containers for Hot Meals May Induce Potential Risk of Allergic Asthma." *Journal of Food Quality Hazards*, Mar. 2017, www.jfqhc.ssu.ac.ir/article-1-306-fa.pdf.
[541] Ibid. Tawfik, MS, and A Huyghebaert. "Polystyrene Cups and Containers..." Food Additives & Contaminants.
[542] "A Method for Analysis of Styrene Dimer and Trimer in Foods and Containers." *Korean Journal of Food Science and Technology*, 2000, www.koreascience.or.kr/article/ArticleFullRecord.jsp?cn=SPGHB5_2000_v32n6_1234.

studies suggest that the level of migratory styrene monomers from any individual food package or container may not be at a high enough level to cause harm, though cumulative impact (from several exposure pathways plus non-chemical stressors) was not considered in the analysis.[544]

Workers in styrene manufacturing facilities are also vulnerable to increased exposure rates through inhalation and skin contact that is unavoidable.[545]

Federal regulatory context

The Federal Food, Drug, and Cosmetic Act (FFDCA), first passed in 1938 and significantly updated in 1997, requires premarket approval of new drugs, food additives, and coloring agents and authorizes standards for levels of pesticides, naturally occurring poisons and toxic additives in or on food products. In addition, the law establishes standards for chemical content in various products and defines departures from those standards as adulteration or misbranding. The FFDCA is administered by the Food and Drug Administration (FDA).

The Food Additives Amendment (FAA) of 1958 required manufacturers of food additives to establish their safety, unless the chemicals are present below established thresholds, or unless they were used in food prior to 1958. Chemical additives above thresholds are considered adulterations unless the FDA specifically approves their use based on safety test data submitted by the manufacturer. Additives must meet the criteria for being "generally recognized as safe" (GRAS) or have an effective premarket notification or petition approval for specific uses. In making such determinations, the FDA may specify conditions of use, the amount of a chemical substance in a product and any required product labeling.

Food contact substances and indirect food additives – which include the polymers that make up plastics, resins and coatings used in can linings and jar lids, pigments, adhesives and biocides – are regulated differently from direct food additives. While the FDA regulates and approves food contact materials partly based on the amounts of food contact substances and indirect food additive chemicals expected to migrate into food (according to information provided by the particular company), they do not require disclosure of food contact substances or indirect food additives on the label as they do for most direct food additives.[546]

There are essentially four ways to establish confirmation of compliance with food safety regulations of a food contact substance or additive.

1. Submit an effective premarket Food Contact Substance Notification.
2. Meet the criteria for status of Generally Recognized as Safe.
3. Obtain a Threshold of Regulation exemption.

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[543] Sung, Jun-Hyun, Kwon, Ki-Sung and Kwang-Ho Lee. "Updated Evaluation of the Migration of Styrene Monomer and Oligomers from Polystyrene Food Contact Materials to Foods and Food Simulants." *Food Additives & Contaminants*, 2014, www.tandfonline.com/doi/full/10.1080/19440049.2013.878040?src=recsys.
[544] Ibid. Sung, Jun-Hyun, Kwon, Ki-Sung and Kwango-Ho Lee. "Updated Evaluation of the Migration of Styrene…" *Food Additives & Contaminants*.
[545] Ibid. Bond, James and Hermann Bolt. "Review of The Toxicology of Styrene." *CRC Critical Reviews in Toxicology*.
[546] Grossman, Elizabeth. "When it Comes to Food Packaging, What we Don't Know Could Hurt Us." *Green Biz*, 27 Oct. 2014, www.greenbiz.com/article/when-it-comes-food-packaging-what-we-dont-know-could-hurt-us.

4. Determine the substance was sanctioned prior to 1958.

The Food and Drug Administration Modernization Act (1997) established the more streamlined option than the previous petition process for determining compliance of new food contact substances: the premarket Food Contact Notification Program within The FDA's Center for Food Safety and Applied Nutrition. The program also regulates chemical ingredients such as sweeteners, artificial flavors, colorants, and preservatives used in processed foods.

FDA guidance outlines basic toxicity tests that manufacturers should undertake before seeking confirmation of compliance with regulations.[547] The Office of Food Additive Safety at the U.S. FDA Center for Food Safety and Applied Nutrition is charged with, among other responsibilities, regulating industry to ensure that food contact substances are safe. The term "safe," as it refers to food additives and ingredients (including food contact substances), is defined as a "reasonable certainty in the minds of competent scientists that a substance is not harmful under the intended conditions of use." The concept of safety hinges upon what constitutes a health hazard and includes the FDA's acknowledgement that it is "impossible to establish with complete certainty the absolute harmlessness of the use of any substance."[548]

While "most direct additives are identified on the ingredient label of foods," most food contact substances and indirect additives are not.[549] Food contact substances, even some that have GRAS status, can be protected as trade secrets, or confidential information.[550]

The primary regulatory option in use today is the Generally Recognized as Safe (GRAS) determination. By far, the most popular methods manufacturers employ for getting a GRAS determination are the self-determination process (approximately 1,000 substances as of 2016) and the associated expert panel route (approximately 2,700 substances as of 2016) which allows manufacturers and their appointed experts to make safety determinations. Manufacturers are protected from chemical disclosure by trade secret laws.[551] The FDA's approvals for phthalates in food contact substances are between 50 and 30 years old, the FDA has taken no regulatory action to limit phthalates in food packaging.[552]

A Pew Charitable Trust report states that "Today, virtually all new chemical additives added directly to food go through the GRAS exemption" wherein manufacturers and their appointed experts are allowed to make their own safety determinations. They further characterize this as a "loophole" that has "effectively swallowed the law."[553] Pew also asserts that FDA has not reviewed

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[547] Ibid. "Poisoned Legacy: Where Consumers Encounter PFCs Today." Environmental Working Group.
[548] "Regulatory Report: Assessing the Safety of Food Contact Substances." U.S. Food & Drug Administration, Sep. 2007, www.wayback.archive-it.org/7993/20171114191242/https://www.fda.gov/Food/IngredientsPackagingLabeling/PackagingFCS/ucm064166.htm.
[549] "Overview of Food Ingredients, Additives & Colors." Food and Drug Administration, 4 Jan. 2019, https://www.fda.gov/food/ingredientspackaginglabeling/ucm094211.htm.
[550] "Title 21: Food and Drugs, Part 170-Food Additives." Electronic Code of Federal Regulations, 20 Dec. 2018, https://www.ecfr.gov/cgi-bin/text-idx?SID=1873b148e86080f2595a862ebeb69ac5&mc=true&node=pt21.3.170&rgn=div5#se21.3.170_139.
[551] Ibid. "What's in the Package?" Clean Water Action and Clean Water Fund.
[552] Ibid. "What's in the Package?" Clean Water Action and Clean Water Fund.
[553] Ibid. "Fixing the Oversight of Chemicals Added to our Food." Pew Charitable Trusts.

the safety of about 3,000 of the 10,000 additives allowed in food, "An estimated 1,000 of these 3,000 are self-affirmed as GRAS by additive manufacturers without notice to or review by the agency, with the balance affirmed as GRAS flavors by an expert panel convened by the flavor industry trade association"[554] whose decisions the FDA monitors but does not review.

While the Food and Drug Administration regulates most aspects of food production and consumption in the United States, the EPA is responsible for regulating the use of pesticides on food. The EPA, in cooperation with the state governments, regulates pesticides to ensure that their use does not compromise food safety.[555] In particular, the Federal pesticide program is designed to ensure that pesticides can be used without posing harm to the most vulnerable members of society, children and infants. The EPA sets tolerances for pesticides appearing in or on foods and the FDA enforces compliance with tolerances through its food inspection program along with the Department of Agriculture's Food Safety Inspection Service.

The Toxic Substances Control Act (TSCA) gives the EPA significantly more authority than FDA to obtain certain information needed to assess the safety of chemicals. About half of the additives to food (more than 4,500) are also regulated by EPA under TSCA, which has the ability to require safety testing of many food contact materials.[556]

Western U.S. regulatory context and local action

Oregon

Plastics are identified by Oregon Department of Environmental Quality (DEQ) as a priority "high impact material" for increasing recovery rates. Plastic bag bans are under consideration at state and city levels as well as by the Metro Council. For example, Metro's 2030 Regional Waste Plan includes an action to "implement policies that will reduce the use of single use products such as single-use plastic bags." Metro's plan also includes an action to "advocate for standards for high-impact products including phase-outs or bans" one to "advocate for legislation that minimizes chemicals of concern in products and packaging and requires the disclosure of product chemicals data to consumers" and one to "partner with the State of Oregon to provide incentives to manufacturers for developing sustainable manufacturing techniques, including green chemistry, for products and packaging sold in Oregon."[557]

Washington

In March 2018, with the passage of HB 2658/SB 6396, Washington became the first state in the country to ban PFAS from food packaging effective January 1, 2021 if certain conditions are met. In the meantime, the Department of Ecology will conduct an assessment to identify safer

[554] Ibid. "Fixing the Oversight of Chemicals Added to our Food." Pew Charitable Trusts.
[555] "US Agencies Involved with Food Safety AG Law Text." North Dakota State University, www.ndsu.edu/pubweb/~saxowsky/aglawtextbk/chapters/foodlaw/USagencies.html.
[556] "Fixing the Oversight of Chemicals Added to our Food." Pew Charitable Trusts, Nov. 2013, www.pewtrusts.org/~/media/legacy/uploadedfiles/phg/content_level_pages/reports/foodadditivescapstonereportpdf.pdf.
[557] Ibid. "2030 Regional Waste Plan…" Metro, March 2019.

alternatives.[558,559] In addition, Washington SB 6248 bans BPA from children's food and beverage containers (other than metal cans) and reusable water bottles.

The City of Seattle has taken measures to limit the waste of single-use food packaging. In 2009, the City of Seattle banned the use of styrofoam and in 2010, the ban on non-recyclable and/or non-compostable single-use and service ware took effect. Additionally, as of July 1, 2018, food service businesses will be banned from providing plastic utensils and therefore must make compostable straws and silverware available for "to go" items.[560]

California

Legislation in California regarding plastic containers overlaps with single use food container legislation. AB 958 (food packaging and highly fluorinated chemicals regulation)[561] prohibits manufacturing of any product containing perfluoroalkyl or polyfluoroalkyl substances PFAS. Additionally, California's AB 1319 (adopted 2011) banned the use of BPA in bottles and sippy cups to be replaced with "the least toxic alternative."[562] Because many children's products also include food and drink containers, there is some overlap with the children's products issue area. Additionally, these food contact materials should be evaluated and are considered priority products under California's Green Chemistry program, the Safer Consumer Products program. Interestingly, California's Rigid Plastic Packaging Container (RPPC) Program (under CalRecycle) which is focused mostly on the manufacture and recycling of plastic rigid containers,[563] *exempts* food containers.

California launched the Safer Consumer Products (SCP) Program[564] in 2013, a green chemistry initiative with a goal to reduce the toxic chemical exposure from everyday product use and to participate in promoting the development and technology around greener products. The process the program takes includes the following:[565]

1. SCP identifies which chemicals pose health or environmental hazards.
2. SCP identifies the products that contain the chemicals. These are called "Priority Products."[566]
3. The companies that make Priority Products will evaluate their use of hazardous chemicals in their products by using the Alternative Analysis process, which involves examining safer alternatives to chemicals of concern.[567]
4. SCP issues a regulatory response.

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[558] Flatt, Courtney. "Inslee Signs Nation's 1st Law Banning Food Packaging Chemicals." Oregon Public Broadcasting, 21 Mar. 2018, www.opb.org/news/article/food-packaging-chemical-perfluorinated-ban-washington/.
[559] "Washington State House of Representatives Office of Program Research Bill Analysis." Environmental Committee, HB 2568, http://lawfilesext.leg.wa.gov/biennium/2017-18/Pdf/Bill%20Reports/House/2658%20HBA%20ENVI%2018.pdf.
[560] "Seattle Food Packaging Requirements." Seattle Public Utilities, www.seattle.gov/util/forbusinesses/solidwaste/foodyardbusinesses/commercial/foodpackagingrequirements/.
[561] "States in the Lead: California." *Safer State*s, www.saferstates.com/states-in-the-lead/california/.
[562] Ibid. "States in the Lead: California." *Safer State*s.
[563] "Rigid Plastic Packaging Container (RPPC) Program." CalRecycle, www.calrecycle.ca.gov/plastics/rppc/.
[564] Ibid. "Safer Consumer Products Program." California Department of Toxic Substances Control.
[565] Ibid. Singla, Veena. "New California program is on a Mission to Reduce Toxic Chemicals in our Everyday Products."
[566] Ibid. "What is a Priority Product?" California Department of Toxic Substances Control.
[567] Ibid. Singla, Veena. "Selecting Safer Alternatives To Toxic Chemicals And Ensuring The Protection Of The Most Vulnerable: A Discussion."

5. Companies make adjustments to the products based on the regulatory response guidelines.[568]

Regulatory context and action in other regions of the U.S., and internationally

Eleven states have passed laws banning BPA from certain food contact materials.[569] Those states include: California, Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New York, Washington, Wisconsin and Vermont (but not Oregon).

In 2012, the FDA rejected a petition put forward by the NRDC to eliminate BPA from food packaging materials.[570] While BPA is banned from certain children's products, the FDA does not believe it needs to be banned for food packaging. Some reporting observed that chemical companies may have engaged in a lobbying campaign to oppose the change in regulations.[571]

In New York State, A 1407 prohibits the sale of liquid, food and beverage containers containing BPA and S 5837 prohibits the use of polystyrene foam for food service packaging.

The FDA recently rejected a petition from the National Resources Defense Council seeking to prohibit use of perchlorate compounds for certain food packaging based on research "showing the likelihood that the dietary exposure may cause permanent damage to a fetus' or infant's brain by irreversibly altering its development." Successful efforts to reduce drinking water exposure standards in water due to recognized dangers have not triggered similar review in food packaging uses.[572]

A 2001 Japanese study found that disposable PVC gloves used in preparation of packaged lunches were the source of high DEHP concentrations.[573] Japan has since stopped the use of gloves containing DEHP in the food service industry[574] as did the E.U. in 2008.[575] The FDA has banned the use of powdered gloves but still allows PVC to be used.[576]

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[568] Ibid. "Final 2018-2020 Priority Product Work Plan." California Department of Toxic Substances Control.
[569] Ibid. "State Laws on BPA." Consumer Reports.
[570] "FDA Rejects NRDC Petition to Remove BPA from Food Packaging." *NRDC*, 30 Mar. 2012, www.nrdc.org/media/2012/120330.
[571] Merkelson, Suzzane. "Lobbying Groups Fight to Stop FDA From Regulating BPA." *Huffpost*, 6 Apr. 2012, www.huffingtonpost.com/suzanne-merkelson/chemical-linked-to-erectile-dysfunction-and-miscarriages_b_1408302.html.
[572] "Denial of Food Additive Petition." Natural Resources Defense Council et al., 4 May 2017, www.federalregister.gov/documents/2017/05/04/2017-08987/natural-resources-defense-council-et-al-denial-of-food-additive-petition.
[573] Tsumura, Y, et al. "Di(2-ethylhexyl) Phthalate Contamination of Retail Packed Lunches Caused by PVC Gloves Used in the Preparation of Foods." *Food Additives and Contaminants*, June 2001, www.ncbi.nlm.nih.gov/pubmed/11407756.
[574] Ibid. "Vinyl Gloves - Protection or Poison?" *Eagle Protect*.
[575] Ibid. "Vinyl Gloves - Protection or Poison?" *Eagle Protect*.
[576] "Banned Devices; Powdered Surgeon's Gloves, Powdered Patient Examination Gloves, and Absorbable Powder for Lubricating a Surgeon's Glove." Food and Drug Administration, 19 Dec. 2016, www.federalregister.gov/documents/2016/12/19/2016-30382/banned-devices-powdered-surgeons-gloves-powdered-patient-examination-gloves-and-absorbable-powder.

Hundreds of healthcare organizations have chosen to eliminate PVC gloves, a movement led by Kaiser Permanente hospitals, which has been replacing PVC in its medical equipment and buildings.[577]

[577] Martin, David. "Companies, Hospitals Move Away from Toxic Material." *Toxic America*, 26 May 2010, www.cnn.com/2010/HEALTH/05/26/abandoning.pvc/index.html.

Community health risk and regulatory context of

Urban pesticides

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: Pesticides are ubiquitously used to kill or disrupt particular organisms in various stages of their life cycle. Exposures to pesticides in the U.S. come from indoor and outdoor application, including herbicides, insecticides, fungicides and disinfectants in and around the home. In addition, the commercial use of pesticides in agriculture, horticulture and property management exposes workers, those living, working or playing near the sites of application, and those who consume food produced with pesticides. This review primarily focuses on indoor use in schools and daycares, multi-family housing, public housing, and outdoor garden use of pesticides. In humans, pesticides are responsible for acute poisonings, are linked to long term health effects including increased risk of adult cancers, adverse effects on reproduction, endocrine disruption and neurological disorders such as Parkinson's disease. An EPA-cited study suggests that 80 percent of most people's exposure to pesticides occurs indoors and that measurable levels of up to a dozen pesticides have been found in the air inside homes. Low-income populations, people of color, middle aged (45 to 64 years) populations, and children can have high exposure rates to pesticides, primarily through exposures in the home.

Regulatory context: Federal authority resides largely with the EPA through the Federal Insecticide, Fungicide, and Rodenticide Act of 1972. The EPA regulates testing, registering, labeling, sales, use and disposal of pesticides to prevent unreasonable adverse effects on human health or the environment. California has one of the most comprehensive pesticide regulation programs in the country - California Department of Pesticide Regulation - which oversees pesticide regulation and works with communities to find reduced-risk pest management alternatives. Pesticide regulation in Oregon is enforced by the Oregon Department of Agriculture. They also manage the Pesticide Exposure, Safety and Tracking Program to track and investigate reports of people exposed to harmful pesticides. State law also directs schools and state agencies in Oregon to implement Integrated Pest Management practices. The European Union expanded its ban of neonicotinoid pesticides based on threats to pollinators to include acetamiprid. Seven Canadian provinces have banned cosmetic use of most pesticides.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals) and non-chemical stressors (such as from racism or socioeconomic status).[578] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

General population and organophosphate and pyrethroid exposure

Two studies from the 1999–2000 National Health and Nutrition Examination Survey (NHANES) reported that up to 76 percent and 96 percent of urine samples tested positive for metabolites of pyrethroids and organophosphates (OP), both chemicals commonly found as ingredients in residential and agricultural pesticide formulations.[579,580] In humans, pesticides are responsible for acute poisonings as well as increased risk of adult cancers, adverse effects on reproduction, endocrine disruption and neurological disorders such as Parkinson's disease.[581]

Domestic applications of pesticides by residents or professional applicators occur indoors, outdoors and on pets. National and regional studies including self-reported data and data collected from environmental sampling found that a majority of U.S. households used pesticides in their homes, yards and/or gardens.[582] A CDC-cited study suggests that 80 percent of most people's exposure to pesticides occurs indoors and that measurable levels of up to a dozen pesticides have been found in the air inside homes.[583]

When used indoors, research has found that oftentimes the applicator doesn't allow for adequate ventilation of the space. A study of pesticide usage patterns found indoor sprays are most commonly used in the kitchen, which may create opportunities for direct and indirect exposures when pesticides contaminate surfaces, and in outdoor areas where people may spend time, thereby increasing likelihood of exposures to pesticide residues after application.[584]

Older adults and pesticide exposure risk

Research suggests that older adults tend to use pesticides in their homes and gardens more than other age groups. One study found that frequency of pesticide use was greatest for those 45 to 64

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[578] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.

[579] Barr, DB, et al. "Urinary Concentrations of Metabolites of Pyrethroid Insecticides in the General U.S. Population: National Health and Nutrition Examination Survey 1999–2002", *Environmental Health Perspectives,* June 2010, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2898848/.

[580] Barr, DB, et al. "Concentrations of selective metabolites of organophosphorus pesticides in the United States population" *Environmental Research,* Nov. 2005, https://www.ncbi.nlm.nih.gov/pubmed/16307973.

[581] Maroni, M, Fanetti, AC, and F Metruccio. "Risk Assessment and Management of Occupational Exposure to Pesticides in Agriculture." *La Medicina del Lavoro*, Mar. 2006, www.ncbi.nlm.nih.gov/pubmed/17017381.

[582] Armes, M, et al. "Residential Pesticide Usage in Older Adults Residing in Central California." *International Journal of Environmental Research and Public Health*, 25 July 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC3166730/.

[583] "Taking an Exposure History What Are Other Potential Sources and Pathways of Hazardous Exposure in the Home and Environment?" Centers for Disease Control Agency for Toxic Substances & Disease Registry, 5 June 2015, www.atsdr.cdc.gov/csem/csem.asp?csem=33&po=8.

[584] Ibid. Armes, M, et al. "Residential Pesticide Usage..." *International Journal of Environmental Research and Public Health.*

years old with the theory that this age group is more likely to own their home and be responsible for the maintenance of their property.[585] This particular study found that pesticide users/applicators were not engaging in behaviors to prevent acute exposures via skin contact or inhalation during applications. Gloves, a mask and coveralls are seldom used as personal protective equipment. In addition, "hanging out" in the areas the pesticides have been applied increases risk of exposure.[586] In this particular study, frequency of pesticide use was not influenced by race.[587]

Low-income communities and residential pesticides

A 1995 study published in the journal *Environmental Health Perspectives* states that "Communities of color are disproportionately exposed to hazardous wastes, dioxin, and air pollution. Existing data demonstrate that children of color are the subgroup of the population most exposed to certain pollutants, including lead, air pollution, and pesticides."[588] Housing is an important determinant of health, and substandard housing is a major public health issue.[589] Low-income and/or ethnic minority communities—already burdened with greater rates of disease, limited access to healthcare, and other health disparities—are often also the populations living with the worst built environment conditions. Studies have shown that negative aspects of the built environment tend to interact with and magnify health disparities, compounding already distressing conditions.[590]

A community-based participatory research study examined indoor pesticide exposure in low-income public housing. Through surface wipes and indoor air quality testing, researchers examined the presence of pesticides in the homes looking specifically for 19 organophosphate (OP) and pyrethroid pesticides.[591] All households contained some level of pesticides, and most commonly in the living room and children's bedrooms. The most commonly found pesticides were the pyrethroids permethrin and cypermethrin (with average concentrations of 2.47 and 3.87 $\mu g/m^2$, respectively).[592]

Several survey and observational studies have indicated that urban low-income, multifamily, public housing dwellings are prone to have severe pest infestations.[593] In one study of pest infestations in low income housing, 81 percent of apartments had infestations of cockroaches, mice, ants, spiders or flies. Pesticide exposure resulting from managing these pests adds to the potential health risks from food contamination and allergens from the infestations. Collectively, findings suggest a high degree of pesticide contamination in these low-income multifamily dwellings. Researchers found

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[585] Ibid. Armes, M, et al. "Residential Pesticide Usage..." *International Journal of Environmental Research and Public Health.*
[586] Ibid. Armes, M, et al. "Residential Pesticide Usage..." *International Journal of Environmental Research and Public Health*.
[587] Ibid. "Residential Pesticide Usage..." *International Journal of Environmental Research and Public Health*.
[588] Mott, L. "The Disproportionate Impact of Environmental Health Threats on Children of Color." *Environmental Health Perspectives*, Sep. 1995, www.ncbi.nlm.nih.gov/pmc/articles/PMC1518919/.
[589] "Housing and Health: Time Again for Public Health Action." *American Journal of Public Health*, May 2002, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1447157/.
[590] Hood, Ernie. "Dwelling Disparities: How Poor Housing Leads to Poor Health." *Environmental Health Perspectives*, May 2005 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1257572/.
[591] Chensheng, Lu. "Household Pesticide Contamination from Indoor Pest Control Applications in Urban Low-Income Public Housing Dwellings: A Community-Based Participatory Research." *Environmental Science & Technology*, 2013, www.pubs.acs.org/doi/full/10.1021/es303912n.
[592] Ibid. Chensheng, Lu. "Household Pesticide Contamination..." *Environmental Science & Technology*.
[593] Ibid. Chensheng, Lu. "Household Pesticide Contamination..." *Environmental Science & Technology*.

that a majority of residents in low-income housing were not educated on how to safely or appropriately use pesticides, and residues were found in nearly 75 percent of apartments.[594]

Traditional professional pest control in low-income multi-family public housing usually consists of an initial 'flush out' (the intensive use of pesticides) followed by periodic applications that only eliminate pests for the short term. As a result, it is often the toughest pests that survive, who transfer resistance to the specific pesticides to their offspring, reducing the efficacy of future applications. In desperation, residents often take pest control into their own hands and resort to the excessive use of over-the-counter products, as well as the use of restricted and illegal pesticides (e.g. Chinese chalk, a highly concentrated form of pyrethroid insecticide). The presence of OP pesticides in households years after their discontinuation highlights the risk of exposure to the occupants stemming from prior frequent indoor applications.[595]

In a study conducted in an agricultural town in California, where the large majority of farmworkers were Hispanic, researchers found that 12 different pesticides were detected in house dust samples of the farmworkers.[596] In Iowa, researchers found elevated levels of herbicides inside homes that were within 750 meters from corn and soybean fields.[597]

Infants and children and pesticide exposure

A study of Northern California households with children under 5 found that 80 percent of these households applied some insecticide. Half reported applications less than four times per year. Twelve percent of these residents were high frequency users of more than 24 times per year. In one out of three indoor applications, children played in the treated rooms on the day of applications and 40 percent played outside in the treated area.[598]

A separate study of homes and daycares found that children 3 to 5 years old were most exposed to pyrethroids via diet, particularly lettuce, spinach and cabbage, unless they were in a home where permethrin is applied and non-dietary ingestion became the dominant exposure pathway.[599]

When exposed, a baby's immature liver and kidneys cannot remove pesticides from the body as well as an adult's liver and kidneys. Infants may also be exposed to more pesticide than adults because they take more breaths per minute and have more skin surface relative to their body weight. Children often spend more time closer to the ground, touching baseboards and lawns where

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[594] Wang, C, Abou El-Nour MM, and GW Bennett. "Survey of Pest Infestation, Asthma, and Allergy in Low-income Housing." *Journal of Community Health*. 22 Aug. 2007, www.entomology.rutgers.edu/personnel/changlu-wang/pdfs/1-Manuscript-JCH.pdf.

[595] Ibid. Wang, C, Abou El-Nour MM, and GW Bennett. "Survey of Pest Infestation...." *Journal of Community Health*.

[596] Ibid. Mott, L. "The Disproportionate Impact..." *Environmental Health Perspectives.*

[597] Ward, MH, et al. "Proximity to Crops and Residential Exposure to Agricultural Herbicides in Iowa." *Environmental Health Perspectives*, June 2006, www.ncbi.nlm.nih.gov/pubmed/16759991?dopt=Abstract.

[598] Wu, XM, et al. "Residential Insecticide Usage in Northern California Homes with Young Children." *Journal of Exposure Science & Environmental Epidemiology*, July 2013, www.ncbi.nlm.nih.gov/pubmed/20588323.

[599] Zartarian, Valerie, et al. "Quantifying Children's Aggregate (dietary and residential) Exposure and Dose to Permethrin: Application and Evaluation of EPA's Probabilistic SHEDS-Multimedia Model." *Journal of Exposure Science & Environmental Epidemiology*, May 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC3331623/.

pesticides may have been applied. Children often eat and drink more relative to their body weight than adults, which can lead to a higher dose of pesticide residue per pound of body weight.[600]

Epidemiologic evidence demonstrates associations between early life exposure to a variety of specific pesticides and pediatric cancers, adverse birth outcomes, neurobehavioral and cognitive deficits and asthma. While organophosphates and carbamates are widely known for their role in incidences of acute poisoning, "numerous other pesticides that may cause acute toxicity, such as pyrethroid and neonicotinoid insecticides, herbicides, fungicides, and rodenticides, also have specific toxic effects."[601] Prospective birth cohort studies in the United States link early-life exposure to organophosphate insecticides with reductions in IQ and abnormal behaviors associated with attention-deficit hyperactivity disorder and autism. Children placed on an organic diet (produced without synthetic pesticides) had immediate decreases in urinary excretion of certain pesticide metabolites.[602]

Urban populations and outdoor volatile organic compounds

A 2018 study found that the use of volatile chemical products (VCPs)—including pesticides, coatings, cleaning agents, printing inks, adhesives, and personal care products—now constitutes half of fossil fuel VOC emissions in industrialized cities in the U.S., and exceeds that from vehicle fuel emissions.[603]

Federal regulatory context

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972 provides authority to the Environmental Protection Agency (EPA) to regulate testing, registering, labeling, sales and use of pesticides, insecticides to herbicides, defoliants, fungicides, and disinfectants to prevent "unreasonable adverse effects on human health or the environment."[604] The Resource Conservation and Recovery Act (RCRA) authorizes the EPA to regulate the transportation, storage and disposal of pesticide wastes, or leftover pesticides that the holder discards. In registration necessary for sale, EPA sets requirements for marketing, distribution, general or restricted use, and disposal of the pesticide. Registration is renewed every five years and may be cancelled or suspended if adverse human or environmental effects are found. The EPA sets tolerance levels for residues on food at a level that provides a "reasonable certainty of no harm" when considering all potential dietary and non-food exposures. Use and disposal is regulated through labeling. Most registered pesticides limit use to trained applicators regulated by state agencies.

The EPA is bound by FIFRA to make regulatory decisions based on risk assessment and cost-benefit analysis using the "reasonable certainty of no harm" threshold. Both the risk assessment process and cost-benefit analysis methodologies are challenged procedurally.

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[600] "Pesticides and Children." National Pesticide Information Center, 2 May 2018, www.npic.orst.edu/health/child.html.

[601] Roberts, James, Karr, Catherine and the Council on Environmental Health. "Pesticide Exposure in Children." *American Academy of Pediatrics*, Dec. 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC5813803/.

[602] Ibid. Roberts, James, Karr, Catherine and the Council on Environmental Health. "Pesticide Exposure in Children." *American Academy of Pediatrics*.

[603] Ibid. "Volatile chemical products emerging as largest petrochemical source of urban organic emissions." *Science*.

[604] "Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Facilities." Environmental Protection Agency, www.epa.gov/enforcement/federal-insecticide-fungicide-and-rodenticide-act-fifra-and-federal-facilities.

The Food Quality Protection Act (FQPA) required the EPA to develop a program to encourage safer pesticides and promote integrated pest management (IPM), a pest management approach that relies on ecological principles and discretely managed pesticide applications. However, programs that were established through FQPA are voluntary and not yet scaled to a point where they present serious alternatives to conventional pest management. FIFRA's narrow focus controlling pesticides rather than promoting safer alternatives to pesticides and IPM may be its greatest limitation.

Pesticide laws have restricted some of the most egregious hazards, pesticide tolerances for human exposure have been reduced, and use has evolved toward more targeted, effective products. Updates in 1996 shifted some of the burden of proof to pesticide manufacturers, created biological screening for endocrine disruption and allowed for separate consideration of vulnerability for children. While these updates represent progress in the sense of reducing impact of the worst offenders, overall use of pesticides has increased, leaving the environment awash in low levels of pesticide residuals with difficult-to-assess biological and ecological effects.[605] There continues to be little information on inert ingredients linked to cancer, birth defects and central nervous system disorders.

In late 2017, rules were adopted to follow the EPA-designated Application Exclusion Zone. OSHA will enforce these rules which requires agricultural pesticide spray zones that move with the point of application to be free of equipment and people who are not trained in the proper application and handling of the pesticides.[606]

See *Regulatory context of chemicals in the United States* for more in-depth information on FIFRA.

Western U.S. regulatory context and local action

Oregon

Pesticide regulation in Oregon is primarily enforced by the Oregon Department of Agriculture (ODA) Pesticide Division (under the Oregon Pesticide Control Act, Oregon Revised Statute 634).[607] The authority to regulate pesticides is primarily delegated from the EPA under FIFRA. The ODA authority includes regulation of formulation, distribution, storage, transportation, application and use of pesticides. Similar to many states, Oregon statute preempts the ability of local governments from adopting or enforcing any regulation regarding pesticide sale or use. Local governments may, however, enact rules regarding use of pesticides on property owned or managed by that government.

Disposal of pesticides is regulated by the Oregon Department of Environmental Quality (DEQ) under authority delegated by the EPA under the Resource Conservation and Recovery Act. DEQ also

[605] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*. p.44.

[606] "OSHA Enforcement of EPA-designated Application Exclusion Zone." Oregon Occupational Safety and Health Administration, 4 Jan. 2018, www.osha.oregon.gov/news/2018/Pages/nr2018-01.aspx.

[607] "Pesticide and Fertilizer Programs." Oregon Department of Agriculture, www.oregon.gov/ODA/programs/Pesticides/Pages/AboutPesticides.aspx.

manages permitting of pesticide applications in, over or on water bodies via authority from the National Pollutant Discharge Elimination System of the EPA under the Clean Water Act.[608]

The Oregon Health Authority (OHA) is charged with protecting drinking water from pesticide contamination via use restrictions near well heads and above surface water intakes of public water systems through authority from the Safe Drinking Water Act and other federal legislation, managed by the EPA. OHA also tracks and investigates reports of people exposed to harmful pesticides through the Pesticide Exposure, Safety and Tracking (PEST) Program.[609]

For pest management in both public and private schools and all state agencies in Oregon, state law requires that they use Integrated Pest Management (IPM) practices.[610] All pesticide applications must be made by a fully licensed applicator and use "low-impact" pesticides. IPM is described by the National Pesticide Information Center operated by Oregon State University as "a pest control strategy that uses a combination of methods to prevent and eliminate pests in the most effective and least hazardous manner."[611]

Oregon HB 3251-1 a Product Stewardship for Household Hazardous Wastes bill - championed by Metro - that did not pass in the 2018 session but is being reintroduced in the 2019 session and includes pesticides among the products it would cover.[612] The bill would require manufacturers to set up and pay for convenient hazardous waste take-back locations and processes for leftover chemical products, reducing exposures to people and the environment.

Washington

Current law in Washington State requires public (K-12) schools and licensed day-care centers to provide notification of their pest control policies and methods upon request of parents or guardians and school employees. This requires parents or employee action to trigger notification.[613] Without proactive disclosure, parents and employees may not be adequately informed to manage risks.

California

The California Department of Pesticide Regulation (DPR)[614] oversees the regulation of pesticide use around the state and works with communities to find "reduced-risk pest management" alternatives. As such, California has one of the most comprehensive pesticide regulation programs in the country.[615] They do this through an "integrated network of programs" which include the following: evaluation and registration of pesticide products, licensing of commercial pesticide application

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[608] "DEQ: Pesticide use in Vicinity of Drinking Water." State of Oregon Department of Environmental Quality, www.oregon.gov/deq/FilterDocs/dwppesticideuseVicdws.pdf.

[609] "Pesticide Exposure, Safety and Tracking (PEST) Program." Oregon Health Authority, www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/PESTICIDES/pages/index.aspx.

[610] "IntegratedPest Management (IPM) in Schools." State of Oregon, www.oregon.gov/ODA/programs/Pesticides/Licensing/Pages/IPMSchools.aspx.

[611] Ibid."IntegratedPest Management (IPM) in Schools." State of Oregon.

[612] Ibid. "Product Stewardship for Household Hazardous Wastes Overview of HB 3251-1." Metro.

[613] "Compliance Guide For the Use of Pesticides At Public Schools (K-12) And Licensed Day-Care Centers." Washington State Department of Agriculture, 2010, https://cms.agr.wa.gov/getmedia/88be51bf-c6ae-47f8-bde7-cb096d29d38c/complguidepub075.pdf.

[614] "About DPR." California Department of Pesticide Regulation, www.cdpr.ca.gov/dprabout.htm.

[615] "How Does California Regulate Pesticide Use?" California Department of Pesticide Regulation, www.cdpr.ca.gov/docs/dept/factshts/main2.pdf.

companies, evaluating health impacts of pesticide use, determining safe pesticide workplace practices, monitoring environmental and health impacts of registered pesticide products, testing for pesticide residue on fruits and vegetables in wholesale centers, and supporting programs that find reduced-risk pest management alternatives. The California DPR meets regularly with stakeholders through its various advisory committees[616] including: The Agricultural Pest Control Advisory Committee, The Pest Management Advisory Committee, and the Pesticide Registration and Evaluation Committee.

Another California initiative that focuses on harmful pesticide use in lower-income communities is Californians for Pesticide Reform.[617] Californians for Pesticide Reform has a Healthy Homes initiative that works to educate tenants about the risks of pesticide use, build active participation in the reduction of pesticide use, increase utilization of low-risk pest management, and promotes policy change around pesticide use.

Regulatory context and action in other regions of the U.S., and internationally

Ontario, Canada

In 2009, Ontario's cosmetic pesticides ban took effect (Ontario Regulation 63/09) after the Pesticides Act was amended by the Cosmetic Pesticides Act. The ban requires that certain listed pesticides cannot be used on lawns, vegetable and ornamental gardens, patios, driveways, cemeteries, parks and school yards. There are a few exceptions (including managing pests for public safety/health reasons or other turfs and forestry lands where pesticides are applied in a controlled manner by trained and certified pesticide application professionals).[618] Seven other Canadian provinces have followed suit in banning cosmetic pesticide use (Quebec, Ontario, Nova Scotia, Newfoundland and Labrador, New Brunswick, and Alberta).[619]

European Union

In April 2018, the European Union expanded its ban of neonicotinoid pesticides based on threats to pollinators to include acetamiprid.[620] This was an expansion of a 2013 ban where the E.U. placed a moratorium on three kinds of neonicotinoids (clothianidin, imidacloprid and thiamethoxam) for use on flowering crops that appealed to honey bees and other pollinators.[621]

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[616] "California DPR Advisory Committees." California Department of Pesticide Regulation, www.cdpr.ca.gov/advcomms.htm.
[617] "Healthy Homes." Californians for Pesticide Reform, www.pesticidereform.org/healthy-homes/.
[618] "Ontario's Cosmetic Pesticide Ban. Ministry of the Environment." *Ontario*, 4 Mar. 2009, www.news.ontario.ca/ene/en/2009/03/ontarios-cosmetic-pesticides-ban.html.
[619] "Pesticide Free BC." *Pesticide Free BC*, 18 Sep. 2013, www.pesticidefreebc.org/index.php?option=com_content&view=article&id=171:pesticide-laws-in-canada&catid=57:canadian-pesticide-regulations-fall-short&Itemid=108.
[620] Stokstad, Erik. "European Union Expands Ban of Three Beonicotinoid Pesticides." *Science Magazine*, 27 Apr. 2018, www.sciencemag.org/news/2018/04/european-union-expands-ban-three-neonicotinoid-pesticides.
[621] "Neonicotinoids." European Union, 30 May 2018, www.ec.europa.eu/food/plant/pesticides/approval_active_substances/approval_renewal/neonicotinoids_en.

Community health risk and regulatory context of chemicals in

Workplace exposures in the service sector

The body of research cited in this literature review is not meant to be comprehensive nor exhaustive, but rather is an initial scan to inform further work. It is also not meant to identify the worst chemicals or products, the most impacted communities, nor specific strategies for solving the problems identified. There are more than 80,000 chemicals in commerce, there are broad gaps in the research, and all people are impacted. General strategies for solving the problems are recommended in the *Conclusion and opportunities for action* section of this Study, but specific solutions will need to be developed in collaboration with community partners and other stakeholders.

Summary

Community health risk: This summary reviewed literature on the levels and types of chemical exposure of several service oriented professions. The specific sectors represent an intersection of high risk chemical exposure potential with predominantly racial and ethnic minority workforces. Many of these workforce sectors pay low wages, which increases the risk of other health stressors associated with their socioeconomic status. Dry cleaning often involves use of tetrachloroethylene (PERC), known for carcinogenicity. Janitorial and house cleaning workers may be exposed to bleach, fragrances, glycol ethers, surfactants, nonylphenol and solvents with associated health impacts including skin conditions, impaired lung function, cancers, endocrine disruption and impaired reproductive function. Furniture foam recyclers and carpet installers may be exposed to flame retardants and volatile organic compounds. Retail workers are exposed to bisphenol-a (BPA) in receipt paper and bills which is "unbound" on the surface of the paper so it wipes off easily onto the hands. BPA has been identified as an endocrine disruptor. The construction workforce may be exposed to volatile organic compounds and asbestos, linked to liver and kidney damage, endocrine disruption, cancer and asbestosis.

Regulatory context: At the national level, exposures in the workplace are regulated by the Occupational Health and Safety Administration. California passed the first healthy nail salon ordinance in the country. Oregon passed legislation aimed at reducing lead and asbestos hazards associated with the demolition of homes. Initiatives are underway nationally to ban the use of PERC and other dry cleaning chemicals, which is already being phased out in California. New York City banned PERC in residential buildings.

Communities, chemicals, and health outcomes

In addition to any disproportionate health risks to specific communities associated with chemicals identified by any specific research in this literature review, communities of color and other historically marginalized groups experience greater impacts than communities with more access to resources - even from identical chemical exposures. This phenomenon is known as Cumulative Risk and accounts for the compounding effect of chemical stressors (exposures to hazardous chemicals)

and non-chemical stressors (such as from racism or socioeconomic status).[622] For a more detailed description of Cumulative Risk, see the *Equity framework* section.

Female hairdressers and salon workers and several chemicals

Hairdressers and salon workers are predominantly women. Ninety-five percent of hairstylists and 85 percent of personal appearance workers are female. Thirty-two percent are African American, Asian or Latinx. They are exposed to several chemicals through their occupation: formaldehyde, toluene, methyl methacrylate, p-phenylenediamine, ammonium persulfate and ammonia.[623,624] Adverse health impacts from these exposures include skin conditions, respiratory conditions, reproductive disorders and birth defects (some intergenerational),[625] cancer, depression, Alzheimer's Disease and other neurotoxic effects, immune disorders and heart disease.[626,627,628]

Dry cleaners and PERC

Tetrachloroethylene (also referred to as perchloroethylene or PERC) is a solvent commonly used in dry cleaning. In 2012 it was classified by the International Agency for Research on Cancer as "probably carcinogenic to humans"[629] and by the EPA as "likely to be carcinogenic to humans." PERC exposure has been associated with bladder cancer, the ninth most commonly diagnosed cancer."[630] The census shows that around 111,000 people are employed at dry cleaners, of which the mean wage is $11/hour and the mean annual salary is $23,050, which means that many dry cleaner workers have a low income.[631]

In addition to direct exposure to PERC, emissions have been shown to contaminate residential indoor air quality around dry cleaners. People who live or work in buildings that share space with dry cleaners that still use PERC may be exposed. Though research is limited, some evidence suggests that even low levels of exposure can cause color vision issues and mild effects on the central nervous system over time.[632] For example, the New York State Department of Health studied residential exposures to PERC in residences located near dry cleaning facilities. The observed associations between elevated indoor air PERC levels and children's Visual Contrast Sensitivity

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[622] Ibid. "The Role of Cumulative Risk Assessment in Decisions about Environmental Justice…" International Journal of Environmental Research and Public Health.
[623] Ibid. "Beauty and Its Beast." *Women's Voices for the Earth.*
[624] Ibid. Pak, Victoria, et al. "Occupational Chemical Exposures Among Cosmetologists, Risk of Reproductive Disorders."
[625] Halliday-Bell, JA, Gissler M, and JJ Jaakkola. "Work as a Hairdresser and Cosmetologist and Adverse Pregnancy Outcomes." *Occupational Medicine*, May 2009, www.ncbi.nlm.nih.gov/pubmed/19270042.
[626] Ibid. Halliday-Bell, JA, Gissler M, and JJ Jaakkola. "Work as a Hairdresser..." *Occupational Medicine*.
[627] Ibid. Harling, M, et al. "Bladder Cancer among Hairdressers: A Meta-Analysis."
[628] Ibid. Gan, Vicky. "The Fight to Rid Black Women's Hair Salons of Toxic Chemicals."
[629] Vlaanderen, J, et al. "Tetrachloroethylene Exposure and Bladder Cancer Risk: A Meta-Analysis of Dry-Cleaning-Worker Studies." *Environmental Health Perspectives*, 21 Mar. 2014, www.ehp.niehs.nih.gov/1307055/.
[630] Ibid. "Tetrachloroethylene Exposure..." *Environmental Health Perspectives*.
[631] "51-6011 Laundry and Dry-Cleaning Workers." Bureau of Labor Statistics, 30 Mar. 2018, www.bls.gov/oes/current/oes516011.htm#nat.
[632] "PERChloroethylene (PERC)." New York City Public Health Department, www.nyc.gov/site/doh/health/health-topics/dry-cleaners-PERChloroethylene.page.

(VCS) suggested that indoor air PERC levels in the range detected may have subtle adverse effects on the brain.[633]

Janitorial workers and several chemicals

Domestic and commercial cleaners are at higher risk for chemical exposure and associated illness, particularly for asthma and skin diseases.[634] Risks are particularly high for window cleaners and dishwashers. The primary chemicals of concern in the workplace for janitors and professional cleaners are bleach, fragrances, glycol ethers, surfactants and solvents, though there are more than 100 identified hazards that occur at varying levels across a wide range of household and industrial cleaners. The multitude of cleaning products used, and the large number of chemical substances present in these products makes predicting and managing for reduced risk difficult. Moreover, cleaning products are constantly changing because of ecological, economic, and consumer demands.[635]

House and office cleaners/maids and several toxins

Women frequently perform a disproportionate amount of housework, including cleaning. One study found that men reported performing 42.3 percent of housework, while women reported performing as much as 79.8 percent.[636] In addition, the cleaning workforce (maids and housekeeping cleaners) are 90 percent women.[637] The children of female cleaning workers are born with higher rates of cleft palates[638] and Down Syndrome.[639] Intrauterine exposure to nonylphenol and nonylphenol ethoxylates, both of which are endocrine disrupting chemicals, and are found in laundry detergents and some soaps has been linked with decreased fetal body length at birth, babies who are small for gestational age, and low maternal weight gain.[640] Women with regular dermal exposure to NP-containing cleaning products have shown measurable levels of NP in their milk, suggesting potential risk to breast-feeding children.[641]

Volatile organic compounds (VOCs) are found in products ranging in the thousands. Some of the most common products containing VOCs include aerosol sprays, cleaners and disinfectants.

Indoor air concentrations of VOCs can be 2 to 5 times greater than outdoors, and VOCs can persist in the air. Researchers have documented short and long-term health effects from VOC exposure

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[633] "Tetrachloroethene (PERC) in Indoor and Outdoor Air Fact Sheet." New York State Department of Health, Sep. 2013, www.health.ny.gov/environmental/chemicals/tetrachloroethene/docs/PERC.pdf.
[634] Jaakkola, JJ and MS Jaakkola. "Professional Cleaning and Asthma." *Current Opinion in Allergy and Clinical Immunology*, Apr. 2006, www.ncbi.nlm.nih.gov/pubmed/16520670.
[635] Gerster, FM. "Hazardous Substances in Frequently Used Professional Cleaning Products." *International Journal of Occupational and Environmental Health*, Mar. 2014, www.ncbi.nlm.nih.gov/pubmed/24804339.
[636] Ibid. Bird, CE. "Gender, Household Labor, and Psychological Distress: the Impact of the Amount and Division of Housework."
[637] "Chart: the percentage of Women and Men in Each Profession." *Boston Globe*, Mar. 2017 www.bostonglobe.com/metro/2017/03/06/chart-the-PERCentage-women-and-men-each-profession/GBX22YsWl0XaeHghwXfE4H/story.html.
[638] Chevrier, C, et al. "Occupational Exposure to Organic Solvent Mixtures During Pregnancy and the Risk of Non-syndromic Oral Clefts." *Occupational and Environmental Medicine*. 20 Apr. 2006, www.oem.bmj.com/content/63/9/617.short.
[639] Ibid. Olshan, A F, et al. "Paternal Occupational Exposures and the Risk of Down Syndrome."
[640] Ming-Song, Tsai, et al. "Neonatal Outcomes of Intrauterine Nonylphenol Exposure—A longitudinal Cohort Study in Taiwan." *Science of the Total Environment,* 1 Aug. 2013, www.sciencedirect.com/science/article/pii/S0048969713004610.
[641] Ibid. Sise, S. and C. Uguz. "Nonylphenol in Human Breast Milk in Relation to Sociodemographic Variables, Diet, Obstetrics Histories and Lifestyle Habits in a Turkish Population."

such as irritation to the mucus membranes, headache, loss of coordination, liver and kidney damage, and endocrine disruption. Some VOCs have been linked to cancer in animals and humans.[642]

Foreign-born and/or immigrant construction demolition workers and several chemicals of concern (primarily lead, silica and asbestos)

Foreign-born workers account for nearly a quarter of the U.S. construction worker force.[643] The percentage of immigrants are even higher for specific construction roles with high exposure to toxics, including painters (48 percent), carpet and flooring installers (46 percent), and hazardous materials removal workers (30 percent).[644] Demolition is a particularly hazardous practice which results in exposure to toxins that become airborne in the process. The primary chemicals of concern include lead, silica, asbestos and mold. A Dutch study found that exposure to respirable dust among demolition workers is five times higher than among carpenters. Prolonged exposure to high concentrations of respirable crystalline silica dust (RCS) can cause silicosis, and studies have shown that Chronic Obstructive Pulmonary Disease (CPOD) is associated with exposure to RCS.[645] Exposures from combustible and hazardous gases related to chemical storage can be highly toxic and are site-dependent.[646]

Worker exposure to lead can occur during the demolition or salvage of structures, during the removal or encapsulation of lead-containing materials, and during new construction, alteration, repair or renovation of structures that contain lead or lead-containing materials.[647] Workers who do not shower and change into clean clothing before leaving the worksite may then contaminate their homes and automobiles with lead dust. Other members of the household may then be exposed to harmful amounts of lead.[648]

OSHA reports in regards to lead that "epidemiological and experimental studies indicate that chronic exposure resulting in blood lead levels (BLL) as low as 10 µg/dL in adults are associated with impaired kidney function, high blood pressure, nervous system and neurobehavioral effects, cognitive dysfunction later in life, and subtle cognitive effects attributed to prenatal exposure. Chronic exposures leading to BLLs above 20 µg/dL can cause subclinical effects on cognitive functions as well as adverse effects on sperm/semen quality and delayed conception. BLLs between 20 to 40 µg/dL are associated with cognitive aging as well as deficits in visuomotor dexterity, lower

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[642] Ibid. "Volatile Organic Compounds' Impact on Indoor Air Quality." Environmental Protection Agency.

[643] Siniavskaia, Natalia. "Reluctant Return of Native-Born Construction Workers Drives the Immigrant Share Up." National Association of Home Builders, Jan. 2018, www.eyeonhousing.org/2018/01/reluctant-return-of-native-born-construction-workers-drives-the-immigrant-share-up/.

[644] Siniavskaia, Natalia. "Immigrant Workers in the Construction Labor Force." *Housing Economics*, Jan. 2018, www.nahbclassic.org/generic.aspx?sectionID=734&genericContentID=260375&channelID=311&_ga=2.94430238.386927543.1524844239-592848277.1524244105.

[645] Kirkeskov, Lilli, Hanskov DJA and Charlotte Brauer. "Total and Respirable Dust Exposures Among Carpenters and Demolition Workers During Indoor Work in Denmark." *Journal of Occupational Medicine and Toxicology*, 2016, www.occup-med.biomedcentral.com/articles/10.1186/s12995-016-0134-5.

[646] "Building Demolition." OSHA, U.S. Department of Labor, www.osha.gov/SLTC/etools/hurricane/building-demolition.html#ras.

[647] "Lead Exposures in Construction." Michigan Occupational Safety and Health Administration, www.michigan.gov/documents/lara/lara_miosha_constfact_lead_exposure_in_construction_413873_7.pdf.

[648] "Request for Assistance in Preventing Lead Poisoning in Construction Workers." Centers for Disease Control, 6 June 2014, www.cdc.gov/niosh/docs/91-116/.

reaction times and attention deficit. At BBLs above 40 µg/dL, workers begin to experience symptoms such as headache, fatigue, sleep disturbance, joint pain, myalgia, anorexia, and constipation. Based on limited evidence of human carcinogenic effects, workers may develop stomach cancer and lung cancer following inhalation exposure to lead."[649]

OSHA medical monitoring protections in place are unlikely to decrease health impacts of lead, particularly among immigrants who face access barriers to the medical system, who may also lack knowledge about medical monitoring, or feel unprepared to self-advocate with employers to be tested. Data suggest that there is significant underreporting of blood lead levels of 25 µg/dl or greater in the construction industry. The data collected suggest that the number of construction workers with blood lead levels 40 µg/dl is underestimated because of poor contractor compliance with OSHA biological monitoring requirements, and that the proportion of workers with blood levels of 40 µg/dl and above is greater in construction as compared to general industry.[650]

Foam recyclers and carpet installers and PBDEs

Carpet installers and foam recyclers have been found to have body burdens of PBDEs that are an order of magnitude higher than the general population.[651] PBDEs are flame retardants used in carpets and foam. Installers are also exposed to VOCs when they are at their highest—during the first 72 hours after installation. Regarding flame retardants - including PBDEs - the National Institute of Environmental Health Sciences warns that "a growing body of evidence shows that many of these chemicals are associated with adverse health effects in animals and humans, including endocrine and thyroid disruption, impacts to the immune system, reproductive toxicity, cancer, and adverse effects on fetal and child development and neurologic function."[652]

Office workers and toxics exposure

All work environments, from construction sites to office buildings, pose some level of risk for exposure to toxic substances. More than 32 million workers (about 20 percent of the entire U.S. workforce) are exposed to hazardous chemical products in the workplace. According to OSHA, 650,000 different chemicals are present in more than 3 million American workplaces.[653]

In one study, concentrations of FTOH (a PFC, or perfluorinated chemical) in offices were discovered to be 3 to 5 times higher than those reported in previous studies of household air, "suggesting that offices may represent a unique and important exposure environment." The study also found a strong link between concentrations of FTOH in office air and perfluorooctanoic acid (a metabolite of FTOH) in the blood of office workers. Results also suggested that workers in newly renovated office buildings may receive considerably higher doses of PFCs than workers in older buildings.[654]

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[649] "Lead Health Effects." U.S. Department of Labor, www.osha.gov/SLTC/lead/healtheffects.html.

[650] "Occupational Blood Lead Surveillance of Construction Workers." The Center for Construction Research and Training, http://www.elcosh.org/document/1046/d000031/Occupational%2BBlood%2BLead%2BSurveillance%2BOf%2BConstruction%2BWorkers%2B-%2BHealth%2BPrograms%2Bin%2BTwelve%2BStates.html.

[651] Stapleton, HM, et al. "Serum Levels of Polybrominated Diphenyl Ethers (PBDEs) in Foam Recyclers and Carpet Installers Working in the United States." *Environmental Science and Technology*, May 2008, www.ncbi.nlm.nih.gov/pubmed/18522133.

[652] Ibid. "Flame Retardants." National Institutes of Environmental Health Sciences.

[653] Ibid. "Toxic Injury at Work." *The Legal Examiner Wiki.*

[654] Ibid. Fraser, Alicia J, et al. "Polyfluorinated Compounds in Serum Linked to Indoor Air in Office Environments."

Indoor VOCs can be 2 to 5 times greater than outdoors, and can persist in the air. Researchers have documented short and long-term health effects from VOC exposure such as irritation to the mucus membranes, headache, loss of coordination, liver and kidney damage, and endocrine disruption. Some VOCs have been linked to cancer in animals and humans, as well as to the genesis of asthma.[655]

Construction workforce and toxics exposure

Seven percent of construction injuries are due to exposure to toxic materials, the most deadly of which is asbestos. Construction is the second most dangerous occupation, behind fishing.[656] In 2014, nearly 2,000 construction workers reported suffering from work-related illnesses affecting their skin or lungs, and 100 of them were poisoned. And, this is only a portion of the impact. The Bureau of Labor Statistics (BLS) reported in 2008 that "as much as 69 percent of injuries and illnesses may never make it into the survey." [657]

Most workplace exposures to toxic chemicals in building materials occur during installation, when workers are directly handling and inhaling chemicals. Exposure may occur from VOCs and other toxics that aerate in the drying and curing processes such as painting, caulking, finishing, sealing and using adhesives.[658] Due to construction schedules, it is likely that interior construction materials toxic to residents and installers may be installed in circumstances in which ventilation systems are not yet operable, further increasing the risk of exposure for these workers.

An increasing proportion of construction workers in the United States are hired as independent contractors by prime- or sub-contractors. Prime contractors do not have any obligation to subcontractors under health and safety regulations. This private arrangement has been successfully challenged in court, yet it persists and may become more of a problem for the health and safety of workers on the job. The U.S. Bureau of Labor Statistics (BLS) estimates that 9 percent of the U.S. workforce is self-employed, but in construction as many as 25 percent of workers are self-employed independent contractors.[659]

Retail workforce exposure to BPAs in receipt paper and bills

Bisphenol-a (BPA) is used as a developer for thermal receipt papers used every day at the point-of-sale in most retail stores,[660] including prescription labels, airline tickets and lottery tickets. Heat from the thermal printing head triggers a reaction between the dye and developer, allowing the

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[655] Ibid. "Volatile Organic Compounds' Impact on Indoor Air Quality." Environmental Protection Agency.
[656] Ibid. "Construction Workers and Asbestos Exposure." Mesothelioma Cancer Alliance.
[657] Duane, Craig. "Construction's Most Common Hazardous Substances." *Jobsite*, 8 May 2017, http://jobsite.procore.com/construction-s-most-common-hazardous-substances.
[658] "Full Disclosure Required." Healthy Building Network, http://healthybuilding.net/reports/14-full-disclosure-required-a-strategy-to-prevent-asthma-through-building-product-selection.
[659] Weeks, James. "Health and Safety Hazards in the Construction Industry." *Encyclopedia of Occupational Health and Safety*, 9 Mar. 2011, www.iloencyclopaedia.org/component/k2/item/518-health-and-safety-hazards-in-the-construction-industry.
[660] "BPA in Thermal Paper." Minnesota Pollution Control Agency, https://www.pca.state.mn.us/green-chemistry/bpa-thermal-paper.

black print to appear.[661] The chemical is "unbound" on the surface of the paper so it wipes off easily onto the hands and onto other things it comes in contact with, especially money in a wallet.

While some sources report that about half of thermal paper receipts are made with large quantities of unbound BPA,[662] all 18 of the thermal papers tested by the Minnesota Pollution Control Agency in 2014 were coated with either BPA or BPS.[663] "While the rate of absorption through the skin and the added risk from handling receipts is not quantified, thermal paper receipts are recognized as a pathway for BPA exposure for people who handle receipts (especially cashiers), and as a mechanism for spreading BPA through the environment."[664] Another study discovered "that BPA transfers readily from receipts to skin and can penetrate the skin to such a depth that it cannot be washed off. This raises the possibility that the chemical infiltrates the skin's lower layers to enter the bloodstream directly. BPA has also been shown to penetrate skin in laboratory studies."[665]

An analysis conducted by the Environmental Working Group (EWG) at the CDC in 2004 found "that people who reported working in retail industries had 30 percent more BPA in their bodies than the average U.S. adult, and 34 percent more BPA than other workers." This is especially remarkable considering that as of 2009, 17 percent of the workforce in America were employed as cashiers and retail salespeople.[666]

BPA has been shown to interact with estrogen receptors and to act as agonist or antagonist via estrogen receptor dependent signaling pathways. BPA has been shown to play a role in the pathogenesis of several endocrine disorders including female and male infertility, precocious puberty, hormone dependent tumors such as breast and prostate cancer and several metabolic disorders including polycystic ovary syndrome (PCOS). Because of the constant, daily exposure and its tendency to bio-accumulate, BPA seems to require special attention such as biomonitoring.[667]

In contrast to conclusions reached after a review of the science by the advisory panel for California's Office of Environmental Health Hazard indicating BPA causes female reproductive toxicity, the FDA's 2018 CLARITY report suggests that "there were no effects in the range of human exposure" and that BPA is safe for "current approved uses in food containers and packaging."[668] While the FDA does not regulate receipt paper, its methodologies and conclusions on safety of toxic substances are nonetheless influential. Commentary from environmental advocates aligns with caution expressed by industry groups. Environmental Health Sciences, a nonprofit, nonpartisan organization dedicated to driving science into public discussion reports that the FDA has traditionally relied upon studies that use decades-old 'standardized' tests that fail to detect many of

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[661] "BPA Coats Cash Register Receipts." Environmental Working Group, 27 July 2010, www.ewg.org/research/bpa-in-store-receipts#.WvPbMtMvzOQ.

[662] Dahl, Lindsay. "On The Money: BPA in Dollar Bills and Receipts." *Safer Chemicals*, 7 Dec. 2010, http://saferchemicals.org/2010/12/07/on-the-money-bpa-in-dollar-bills-and-receipts/.

[663] Ibid. "BPA in Thermal Paper." Minnesota Pollution Control Agency.

[664] Ibid. "BPA in Thermal Paper." Minnesota Pollution Control Agency.

[665] Ibid. "BPA Coats Cash Register Receipts." Environmental Working Group.

[666] Ibid. "BPA Coats Cash Register Receipts." Environmental Working Group.

[667] "Health Risk of Exposure to Bisphenol A (BPA)." National Institute of Public Health, 2015, www.ncbi.nlm.nih.gov/pubmed/25813067.

[668] Konieczna, A, Rutowska, A, and D Rachon. "Academics Urge Caution in Interpreting CLARITY-BPA Results." *Chemical Watch*, 1 Mar. 2018, http://chemicalwatch.com/64449/academics-urge-caution-in-interpreting-clarity-bpa-results.

the adverse effects caused by exposure to very small amounts of BPA. Hence, the FDA is not examining cases similar to those most Americans experience on a daily basis.[669] Regulating thermal paper is also a contentious issue outside the U.S. The European Chemicals Agency (ECHA) committee for socio-economic assessment concluded "the social and economic costs of banning bisphenol A (BPA) in cash register receipts outweigh any long-term benefits."[670] The Minnesota Pollution Control Agency determined that amidst controversial testing protocols and cost-based risk assessments, the most promising prevention strategy is going paperless and switching to e-receipts.[671]

Federal regulatory context

Chemical exposures in the workplace are covered by the Occupational Health and Safety Act (OSHA) of 1970 designed to reduce workplace hazards and implement safety and health programs for both employers and their employees. The act created the Occupational Health and Safety Administration (also called OSHA) and the National Institute for Occupational Safety and Health (NIOSH).

Several other federal regulations restrict or guide production, transport, use or disposal of products containing hazardous chemicals available to the service sector professions reviewed here. These include the Toxic Substances Control Act, Resource Conservation and Recovery Act, Federal Insecticide Fungicide and Rodenticide Act, Consumer Product Safety Act and others. In this review OSHA is the primary focus.

OSHA Act gives employees rights, including:

- get clear training and information in layman's terms on the hazards of their workplace, ways to avoid harm, and applicable OSHA standards and laws
- access copies of any tests done to measure workplace hazards (e.g. chemical, air and similar testing) and obtain and review documentation on work-related illnesses and injuries at the job site
- confidentially make a complaint with OSHA to have an inspection of the workplace and not be discriminated or retaliated against.

Employers are obligated to:

- provide a safe workplace free of serious hazards
- actively identify health and safety hazards and eliminate or minimize them; or provide employees with adequate safeguards and protective gear
- notify employees of any hazards and provide the training necessary to address them
- post a list of OSHA injuries and citations and maintain records of work-related injuries.

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[669] Saal, Frederik V., et al. "Commentary: FDA statement on BPA's Safety is Premature." *Environmental Health News*, 5 Mar. 2018, www.ehn.org/fda-flawed-statement-science-bpa-2542621453.html.
[670] Gunther, Matthew. "Chemical Regulatory Committee Recommends No Action on Basis of Socio-economic Analysis." *Chemical Watch*, 14 Dec. 2015, www.chemistryworld.com/9255.article.
[671] Ibid. "BPA in Thermal Paper." Minnesota Pollution Control Agency.

NIOSH is a federal agency responsible for conducting research in the field of occupational safety and health and making recommendations for the prevention of work-related injury and illness. NIOSH is charged with recommending occupational safety and health standards and describing exposure levels that are safe for various periods of employment, including but not limited to the exposures at which no worker will suffer diminished health, functional capacity or life expectancy as a result of his or her work experience. NIOSH communicates recommended standards to regulatory agencies (including OSHA), health professionals in academic institutions, industry, organized labor, public interest groups, and others in the occupational safety and health community through criteria documents.

The traditional practice of worker protection is based on setting occupational exposure limits (OELs) for airborne contaminants. "Strict reliance upon sampling and analyzing airborne contaminants and comparing results with OELs has become increasingly difficult in recent decades because of the growing number of hazardous chemicals. The increasing number far outweighs the ability and resources—of government and other agencies external to chemical manufacturers—to determine associated OELs."[672]

Under OSHA, permissible exposure limit (PEL or OSHA PEL) is a legal limit in the United States for exposure of an employee to a chemical substance or physical agent. ''In the absence of established PELs, employers and workers often lack the necessary guidance on the extent to which occupational exposures should be controlled."[673] OSHA's current PELs cover only a small fraction of the tens of thousands of chemicals used in American workplaces. David Michaels, who served as head of OSHA from 2009 to 2017, noted in 2014 that "many of our chemical exposure standards are dangerously out of date and do not adequately protect workers."[674]

Additional detail on federal regulation of specific chemical hazards present in service sector workplaces can be found in the following sections of this Study: *Building materials*, *Carpet*, *Cleaning products for the home*, and *Personal care products*.

Western U.S. regulatory context and local action

California - Nail salons

In 2016, California passed the first healthy nail salon ordinance in the country (AB 2125)[675] which established best practices and banned certain chemicals used in salons (dibutyl phthalate, formaldehyde or toluene) Salons that wish to receive recognition and certification can look to The Department of Toxic Substances Control guidelines for local jurisdictions to voluntarily implement local healthy nail salon recognition (HNSR) programs.[676] Guidelines include information on chemical exposure, healthy alternatives, a consumer education program, and training and

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[672] "Qualitative Risk Characterization and Management of Occupational Hazards: Control Banding (CB)." Center for Disease Control NIOSH, Aug. 2009, www.cdc.gov/niosh/docs/2009-152/pdfs/2009-152.pdf.
[673] Ibid. "Qualitative Risk Characterization..." Center for Disease Control NIOSH.
[674] Smith, Sandy. "OSHA: Workers Are Not Being Protected From Chemical Hazards." *EHS Today,* 9 Oct. 2014, www.ehstoday.com/safety/osha-workers-are-not-being-protected-chemical-hazards.
[675] "Assembly Bill No. 2125." California Legislative Information, 24 Sep. 2016, http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2125.
[676] "Program Guidelines." Environmental Protection Agency, Apr. 2018, https://dtsc.ca.gov/wp-content/uploads/sites/31/2018/10/AB2125-HNSR-Program-Guidelines.pdf.

certification requirements for healthy nail salon recognition. Another local resource working on nail salon health standards is the California Healthy Nail Salon Collaborative.[677]

The California Healthy Nail Salon Collaborative notes that there are nearly 200 Certified Health Nail Salons in California.[678] San Francisco alone has over 50 registered nail salons.[679]

Washington - Nail salons and dry cleaners

King County's Local Hazardous Waste Management Program provides some outreach to address the challenge of communicating the risks of toxic exposures cross-culturally in salons and among dry cleaners.[680,681] A 2010 survey sent to every dry cleaner in King County found that 84 percent were Korean, 69 percent used PERC and 75 percent did not know the chemical was harmful to their health.[682] King County is responding to requests to translate technical information into primary spoken languages and find funds to incentivize business owners to reduce hazardous materials.

Oregon - Construction industry

In the construction industry, lead is the big focus of toxics reduction efforts. Demolition is a cause for concern locally in part due to Portland's growth rate. In 2016, Portland City Council passed one of the first deconstruction ordinances in the country. The ordinance aims to ensure safer deconstruction of buildings built in 1916 or earlier or designated historic resources, to prevent exposure to lead dust and to salvage valuable materials for reuse.[683] This ordinance led to the deconstruction of approximately 180 single-family homes in Portland during its first two years. The required practices reduce the amount of waste generated, limit carbon emissions and reduce exposure to harmful lead and asbestos dust.

In 2017, the Oregon Senate passed SB 871 that enables city governments to manage lead and asbestos hazards associated with the demolition of homes.[684]

On February 1, 2018, Tony Green, the Deputy Ombudsman with the City Auditor's Office in Portland, explained before City Council why Portland's 2016 deconstruction ordinance did not include properties built after 1916.[685] He noted the initial goal was not to overwhelm the fledgling deconstruction market. However, this left out many homes built before 1978 when the use of lead paint halted. In 2018 the Portland City Council passed the Asbestos and Lead-Based Paint Mitigation in Residential Demolitions (an SB 871 Implementation Ordinance) to close that regulatory gap.

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[677] "Home Page." California Healthy Nail Salon Collaborative, www.cahealthynailsalons.org.
[678] "CA Certified Healthy Nail Salons." California Healthy Nail Salon Collaborative http://cahealthynailsalons.org/find-a-healthy-nail-salon-2/.
[679] "Recognized Health Nail Salons San Francisco." *Data SF,* http://data.sfgov.org/Energy-and-Environment/Map-of-Recognized-Healthy-Nail-Salons-in-San-Franc/mird-5wmf.
[680] "Healthy Nail Salons." Local Hazardous Waste Management Program in King County, Washington, www.hazwastehelp.org/health/nail-salons.aspx.
[681] "Dry Cleaners." Local Hazardous Waste Management Program in King County, Washington, www.hazwastehelp.org/health/drycleaners.aspx.
[682] Ibid. "Dry Cleaners." Local Hazardous Waste Management Program in King County, Washington.
[683] Ibid. "Deconstruction Requirements." City of Portland Bureau of Planning and Sustainability.
[684] Ibid. Schick, Tony. "Oregon Lawmakers Look To Close Demolition Loophole For Lead Dust."
[685] Ibid. "Containing Toxic Dust during Demolitions." City of Portland Deputy Ombudsman Remarks.

Regulatory context and action in other regions of the U.S.

Initiatives are underway nationally to clean up dry cleaning by banning the use of PERC and PBT used in spot cleaners. California banned PERC in 2009 with a horizon for phasing out all use by 2023. New York City banned PERC in residential buildings. An industry report from 2014 notes that though PERC remains in use by 50 percent of dry cleaners, business owners surveyed recognize impacts and anticipate PERC will be phased out within five to ten years.[686]

In 1997, New York State adopted regulations to reduce emissions from dry cleaners to prevent adverse impacts in minority neighborhoods.[687]

[686] Beggs, Bruce. "Survey: Many Dry Cleaners Give PERC Another 10 Years or Less as Solvent Option." *American Trade Magazines*, 8 Oct. 2014, http://americandrycleaner.com/articles/survey-many-dry-cleaners-give-PERC-another-10-years-or-less-solvent-option.

[687] McDermott, MJ. "Tetrachloroethylene (PCE, PERC) Levels in Residential Dry Cleaner Buildings in Diverse Communities in New York City." *Environmental Health Perspectives*, Oct. 2005, www.ncbi.nlm.nih.gov/pubmed/16203243.

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REGULATORY CONTEXT OF CHEMICALS IN THE UNITED STATES

> *"The prevailing regulatory approach in the United States is reactionary rather than precautionary. That is, instead of taking preventive action when uncertainty exists about the potential harm a chemical or other environmental contaminant may cause, a hazard must be incontrovertibly demonstrated before action to ameliorate it is initiated."*
>
> *-The President's Cancer Panel, 2010*[688]

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Introduction to the regulatory context

The purpose of this Study was to identify opportunities to lower health risks and address disparate impacts associated, in part, with policy shortcomings. To help accomplish this we focus here on understanding the weaknesses, gaps and challenges of existing federal policy. References include a number of sources from federal agencies, academic research, industry and reputable advocates for health and the environment. The two primary sources were a study - commissioned by Metro and partners - titled *Leadership in Sustainable Chemicals Policy: Opportunities for Oregon* by Jennifer H. Allen, Ph.D. and Alexis Dinno of Portland State University and *Chemicals Without Harm: Policies for a Sustainable World* by Ken Geiser published by MIT Press.

Existing chemicals policy in the United States does not comprehensively protect human health or the environment from the potential impacts of chemical exposure. The U.S. has a weak regulatory structure and too little information to effectively understand collective risks or incentivize innovation. The policy framework is fragmented, coordination among players with overlapping jurisdictions is lacking, standards for assessing risks are inconsistent, and there is too little investment in development of safer alternatives.[689]

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[688] "Reducing Environmental Cancer Risk." Health & Environmental Funders Network, Apr. 2010, https://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf.

[689] "Leadership in Sustainable Chemicals Policy: Opportunities for Oregon." Portland State University, Jun. 2011, https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1042&context=iss_pub.

The suite of federal policies related to chemicals in our food, cosmetics, consumer products and manufactured goods that form the foundation of chemical policy in the U.S. were largely passed in the early 1970's. Then, as now, policy conversations arose from what some have called an outdated worldview characterized by separation and competition. Objects, processes and chemicals were typically viewed as discrete and isolated, rather than constantly interacting and changing at scales far below what human senses and technology of the era could detect.[690] Distinct policies to address specific industry sectors and independent institutions to oversee different types of chemical-containing products according to their uses were created. Separate Federal agencies established their own protocols for assessing risk and methods for testing toxicity. These various agencies have largely relied on industry for data and focused on single chemicals and risks limited to the specific manufactured form of the chemical and its stated use.

Given the political influence of industry combined with economic policies favoring deregulation and efforts to shrink government, it is not surprising that the resulting tapestry of chemical regulations is complex, overlapping, underfunded and fraught with gaps.[691] Industry holds an outsized negotiating position in this fragmented policy environment relying on scientific standards of risk evaluation adopted nearly 50 years ago. The chemicals policy approach has historically focused on control with regulatory intent aimed at mitigating harm once sufficient proof existed to justify restrictions on free-market capitalism in the name of protecting human and environmental health. As a result, "nearly 80,000 chemicals on the market in the United States, many of which are used by millions of Americans in their daily lives, are un- or understudied and largely unregulated."[692]

In short, chemicals are considered safe until proven unsafe. Industry retains responsibility for producing and selling safe products and the government's role is primarily to act in a public health crisis. Protecting public health has focused on accurate labeling and the government has historically held the burden of proof in demonstrating a commercial product unsafe. However, high risk thresholds, lengthy testing protocols and limited funding translate into little effective capacity to control the hundreds of thousands of chemicals to which people are exposed.

New science is increasingly driving new thinking. As worldviews grow to include a more holistic systems perspective and access to information via the internet fuels consumer demand for action, some governments have moved to adopt approaches based on the precautionary principle. As a result, some chemicals policies outside the U.S. are shifting from control to prevention strategies, particularly in Europe, but also in China and Korea. As the orientation toward "do no harm" grows more popular, public interest in avoiding shared human, environmental and medical costs is beginning to shift the burden of proof to industry. Rather than staying below acceptable thresholds of harm, manufacturers are increasingly being asked to prove their products are safe or remove them from the marketplace.

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[690] Wahl, Daniel. *Designing Regenerative Cultures*. Triarchy Press, 31 May 2016.
[691] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.
[692] "Reducing Environmental Cancer Risk." President's Cancer Panel, U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute, April 2010, https://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf.

Our knowledge of risks outpaces our ability to implement corrective policy changes that reconcile current research with health and safety. We know there are huge gaps in data, and increasingly the evidence shows that thousands of chemicals in daily use are toxic, persistent, and bioaccumulate in the body and in the environment. Industry, often more adaptive than regulators, has responded to control strategies by creating new compounds that in practice avoid legal restrictions. A subtly modified molecular structure is technically different, but often poses similar biological harms which take years to be documented and addressed. Due to limited testing authority and grossly inadequate budgets relative to the number of chemicals on the market, only the most harmful chemicals are prioritized for study. Since 2016, the federal government has new authority to require testing with some of the costs borne by industry, but gaps and challenges in implementation remain.

In the absence of effective regulation, concerned philanthropists, attorneys, industry leaders and others are stepping up calls for action and making progress to protect public safety in the name of social responsibility. States and local governments are taking legislation into their own hands and filling gaps in federal policy. Future-focused members of industry track global trends toward nontoxic replacement initiatives and look for ways to adapt before consumers or policies force them to change and as a means to drive innovation. Many sectors are investing in green chemistry as a means of producing less harmful replacements for toxic chemicals currently in use.

Publications from the EPA suggest evidence of a more holistic worldview taking hold. The Plain English Guide to Clean Air from 2007 notes awareness of chemicals' pathways through living systems. "Toxic air pollutants, like mercury or polychlorinated biphenyls, deposited onto soil or into lakes and streams persist and bioaccumulate in the environment. They can affect living systems and food chains, and eventually affect people when they eat contaminated food."[693] The 2016 Drinking Water Action Plan recognizes the importance of agency collaboration and adaptive capacity. "It is important to recognize that the Priority Areas, strategies and proposed actions identified above are not isolated from one another. There is intensive overlap between actions, and success will require that these elements be considered and addressed in an integrated and strategic way, working closely with our federal, primacy agency and local partners, the regulated community and external stakeholders. As we move forward, EPA will work with stakeholders in an iterative manner to assess progress, resources and priorities."[694] Continued application of broad, holistic thinking will be necessary to integrate current science to address the complexity of responses required to meet current public health, environmental and climate change priorities.

[693] "The Plain English Guide to the Clean Air Act." EPA Office of Air Quality Planning and Standards, Apr. 2007, p. 16, https://www.epa.gov/sites/production/files/2015-08/documents/peg.pdf.
[694] "Drinking Water Action Plan" Office of Water, EPA, Nov. 2016, p.24 https://www.epa.gov/sites/production/files/2016-11/documents/508.final_.usepa_.drinking.water_.action.plan_11.30.16.v0.pdf.

Overview of a failure to effectively regulate chemicals in the U.S.

The federal Government Accountability Office (GAO) recognizes oversight of food safety and the EPA's processes for assessing and controlling toxic chemicals among the 32 high risk areas, with both areas likely to require legislation to effectively address risk.[695]

"It is well documented that federal chemicals policy has not been effective in assessing chemical hazards or controlling chemicals of concern."[696] This policy critique and others like it from independent academics are corroborated by a full spectrum of voices including the GAO, federal agency officials, industry trade associations and environmental advocates. Very few of the 84,000 chemical substances used for commercial purposes in the United States have been studied for health and environmental impacts. We don't know how most chemicals are used nor what hazards they pose. Limited scientific information about hazards and impacts is further limited by the manufacturer's right to classify insider knowledge as confidential business information. A data gap exists because evidence of harm has generally been required for demanding federal testing, but manufacturers are not required to disclose potential hazards. The data gap leads to a safety gap. Without access to data establishing risk, agencies cannot initiate studies to obtain data to establish risk, much less to manage the risk. This hampers administrators' ability to establish thresholds to protect public and environmental health.

"The factors that have limited a comprehensive and rational approach to chemical safety include the following: a government burden to demonstrate 'unreasonable risk' rather than a manufacturer burden to demonstrate that a chemical entering commerce is safe; limited federal authority to require health and safety data; lack of agency capacity to analyze large amounts of data for thousands of chemicals in a timely manner; procedural complexity for implementing the law, inconclusiveness of data, or failure of replication in testing outcomes resulting in regulatory stalemate; and finally, delays arising from corporate legal challenges that frequently follow new chemical safety rules."[697]

On average, "it has taken 20–25 years after a chemical has entered the commercial market to strictly regulate or prohibit its use, as in the case of lead, PCBs, asbestos, and dichlorodiphenyltrichloroethane (DDT). Manufacturers challenge the science and use the uncertainties in the risk assessment opportunistically to demand further studies until there is unimpeachable consensus that the chemical is a public health hazard."[698] With the update to TSCA in 2016, actions on priority chemicals have relatively short deadlines, but these do not preclude delays from legal challenges.

Experts identify a fundamental shortcoming of U.S. chemical policies is that they "treat chemicals as if they exist in isolation from their environment, do not combine with each other and do not flow

[695] "High Risk Series." United States Government Accountability Office Report to Congressional Committees, Feb. 2015, https://www.gao.gov/assets/670/668415.pdf.
[696] Ibid. "Leadership in Sustainable Chemicals Policy: Opportunities for Oregon." Portland State University.
[697] "The Unsteady State and Inertia of Chemical Regulation Under the U.S. Toxic Substances Control Act." PLoS Biology, 18 Dec. 2017, http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2002404.
[698] Ibid. "The Unsteady State and Inertia of Chemical Regulation Under the U.S. Toxic Substances Control Act." PLoS Biology.

between media."[699] This is contrary to the basic reality that humans are rarely exposed to chemicals one at a time. We know that chemicals bioaccumulate, combine in unpredictable ways in the environment, and flow through air and water as well as migrate between products and materials. Proving risk beyond reasonable doubt is a very high standard of proof that is often impossible to reach due to insufficient data. Further, when limited testing is conducted, it is focused on chemicals in isolation. There are currently no standards for assessing harmful effects based on toxicity of chemical mixtures. These shortcomings perpetuate the data gap.

Federal policy reform efforts to increase enforcement are slow and fall far short of what's necessary to protect human health and environmental quality.[700] Advocates for change, among them The Lowell Center for Sustainable Production, recommend a more comprehensive policy framework that offers an "integrated and prevention-oriented" approach that ensures "protection of workers, communities, and consumer health while stimulating the development and use of non-hazardous and sustainable chemicals in production systems, materials, and products."[701] Critical elements include an integrated approach to all chemicals; rapid assessment, prioritization, and decision-making on inherent toxicity that would drive policies related to manufacturing, use, and disposal; adequate data collection; and consideration of hazard (not risk) to spur transition to low-hazard substances.

In a strong regulatory environment, public policies provide rules that establish structure for markets. In a weak regulatory environment, generating demand for safer alternatives requires consumers be highly educated and to integrate their health and environmental values into purchasing decisions. Without consumer demand there is insufficient incentive to drive business investment into research and development of alternatives (aka create safer options using green chemistry). Without a viable pipeline of future revenue streams, industry is more likely to resist regulation because restricted uses of chemicals impact businesses by reducing profits. This results in a technology gap that drives industry resistance to policy reform.

For example administrative actions carried out by appointed industry insiders over the last few years have lowered the safety obligations of chemical manufacturers.[702] This has been accomplished through a variety of means from overt changes in policy to subtle changes in definitions, standards and practices. This is not new. Regardless of who has controlled the administration or Congress over the past many decades, the majority of the burden has been placed on the public at large for understanding risk, avoiding exposure and bearing the costs of mitigating negative impacts of chemicals.

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[699] Ibid. "Leadership in Sustainable Chemicals Policy: Opportunities for Oregon." Portland State University.
[700] Ibid. "Leadership in Sustainable Chemicals Policy: Opportunities for Oregon." Portland State University, p. 2.
[701] Ibid, "Leadership in Sustainable Chemicals Policy: Opportunities for Oregon." Portland State University, p. 5.
[702] "Trump's EPA May Be Weakening Chemical Safety Law." *Scientific American*, Aug. 16 2017, https://www.scientificamerican.com/article/trump-rsquo-s-epa-may-be-weakening-chemical-safety-law/.

INDUSTRY SNAPSHOT

The global chemical industry in 2010 was valued at $4.12 trillion. Annual global production nearly doubled between 2000 and 2010. Production by OECD countries (The Organisation for Economic Co-operation and Development) is falling, now roughly 63 percent while industry in Asia and Latin America grew. China is the largest chemical producing country in the world.[703]

The U.S. chemical industry is valued at $720 billion and comprises 70,000 products that constitute 12 percent of the manufacturing sector of the economy. There are 13,500 chemical manufacturing facilities in the U.S. Bulk producers are located largely in Texas, Louisiana, New Jersey, Pennsylvania and California. Specialty chemicals tend to be produced by small companies. These include ingredients in electronics, coatings, inks/dyes, advanced polymers, surfactants and pharmaceuticals.[704]

The Oregon chemical industry employed about 4,500 people in 2017. The green chemistry/organic segment of chemical manufacturing grew by 188 percent between 2001 and 2017. The largest segment (almost 20 percent of the sector) is pharmaceutical and medicine manufacturing, also heavily influenced by nutritional, herbal, and natural products. Despite projected declines nationally, the Oregon chemical industry is expected to grow, particularly in biofuels, organic fertilizers and supplement markets.[705]

Prominent policy gaps

The following highlights key gaps in the federal regulation of chemicals. For a more detailed description of the regulations themselves, see *Appendix 1: Federal regulation history and structure*.

Cosmetics

Although the word "cosmetics" is used in the title "Federal Food, Drug, and Cosmetic Act" (FFDCA), the Food and Drug Administration (FDA) has little authority over the safety of cosmetics. Under the law, the FDA is not authorized to require cosmetic manufacturers to register their products with the FDA, nor disclose the chemical ingredients in their products, neither to the FDA nor to the public, and it cannot require them to substantiate product safety or performance claims. Voluntary reviews are sometimes conducted by an industry trade association with registration of cosmetics and fragrances of particular concern, but few participate.

Food contact materials

The Pew Charitable Trust reports "Today, virtually all new chemical additives added directly to food go through the Generally Recognized as Safe (GRAS) exemption: This loophole has effectively swallowed the law."[706] "Pew determined that FDA has not reviewed the safety of about 3,000 of the 10,000 additives allowed in food. An estimated 1,000 of these 3,000 are self-affirmed as GRAS by

[703] "Chemicals in the Context of Sustainable Development Goals." https://sdg.iisd.org/commentary/guest-articles/chemicals-in-the-context-of-sustainable-development-goals/.
[704] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.
[705] "Oregon's Chemical Manufacturing Industry Changes to Meet Demand." State of Oregon Employment Department, 7 May 2018, https://www.qualityinfo.org/-/oregon-s-chemical-manufacturing-industry-changes-to-meet-demand.
[706] "Fixing the Oversight of Chemicals Added to Our Food." Pew Charitable Trust, 7 Nov. 2013, https://www.pewtrusts.org/en/research-and-analysis/reports/2013/11/07/fixing-the-oversight-of-chemicals-added-to-our-food.

additive manufacturers without notice to or review by the agency, with the balance affirmed as GRAS flavors by an expert panel convened by the flavor industry trade association"[707] whose decisions the FDA monitors but does not review.

Since a core component of the FDA's regulation of food contact materials is based on the assumption that these substances may migrate into and be present in food, many feel the public has a right to know what may be in their food and drinks. However, food packaging chemicals are not always disclosed by industry to the FDA and in many cases the toxicology or exposure data do not exist. More importantly "The individual chemical assessments that determine food contact material approvals may not capture all the ways in which a single substance may interact with food, human bodies or the environment."[708] Jane Muncke, managing director and chief scientific officer of the Zurich-based nonprofit Food Packaging Forum believes that in addition to the materials themselves, these substances' chemical breakdown and by-products need to be considered in assessing health impacts. Many more individual chemicals may be touching food, and therefore be detectable in food, than only those present in the packaging as formulated. This is particularly true for polymers in plastics that break down generating significant by-products.

Significant policy shortcomings identified by PEW include:

- Conflicts of interest. Food manufacturers make GRAS safety decisions without FDA's knowledge despite conflicts of interest among those making the determinations. The GRAS loophole as currently used is inconsistent with Congress' plan and the practices of other developed countries.
- Lack of information. FDA lacks even basic information needed to assess the safety of thousands of chemicals that have been cleared for use in food. As a result, the agency reevaluates the safety of only a relative handful of existing additives.
- Outdated science. FDA uses outdated science to evaluate additive safety. It relies on a process that does not ensure independent scientific input and is often not transparent, particularly for food contact substances.[709]

The PEW Report concluded, "systemic problems plaguing the food additive regulatory program prevent FDA from ensuring the safety of all chemicals added to our food."[710]

Pesticides

The EPA is bound by FIFRA to make regulatory decisions based on risk assessment and cost-benefit analysis, and both are challenged procedurally. The following criticisms are identified by Geiser and corroborated by various other sources, including the GAO, federal agency officials, and environmental advocates and attorneys.

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[707] Ibid. "Fixing the Oversight of Chemicals Added to Our Food." Pew Charitable Trust, p. 5.
[708] "When it Comes to Food Packaging, What We Don't Know Could Hurt Us." *Ensia*, 13 Oct. 2014, https://ensia.com/features/when-it-comes-to-food-packaging-what-we-dont-know-could-hurt-us/.
[709] Ibid. "Fixing the Oversight of Chemicals Added to Our Food." Pew Charitable Trust, 2013.
[710] Ibid. "Fixing the Oversight of Chemicals Added to Our Food." Pew Charitable Trust, p. 12.

Criticism and concerns of risk assessments:

- Condense large amounts of uncertain and ambiguous data, much of which has been modeled and extrapolated beyond what is actually measured, down to a single numerical indicator.
- Large gaps in the toxicological data on which the hazards of chemicals are assessed.
- Broad ranges of human susceptibility.
- Limited knowledge about the biological mechanisms that bring about disease.
- Exposure pathways are difficult to predict over the life cycle of substances.
- Exposure models are often controversial.
- Credibility problems in dose-response assessments where data are extrapolated across species from test animals to humans and from high testing doses to the low doses of likely human exposures.

Criticism and concerns of cost-benefit analysis:

- Over-values factors that can be costed and undervalues factors such as good health and ecological quality that are difficult to monetize and thereby protects the status quo rather than driving changes that have significant costs.
- Analyses involve so many assumptions, judgment calls, value determinations and un-quantifiable factors that analysis is unconvincing.
- Conflates multidimensional problems into simplistic calculations and can create a false sense of confidence in decision makers.

The FQPA (Food Quality Protection Act) required the EPA to develop a program to encourage safer pesticides and promote integrated pest management (IPM), a pest management approach that relies on ecological principles and discretely managed pesticide applications. Programs that were established are voluntary and not scaled to present serious alternatives to conventional pesticides.[711]

Pesticide laws have restricted some of the most egregious hazards, pesticide tolerances for human exposure have been reduced, and use has evolved toward more targeted, effective products. While this represents progress in the sense of reducing impact of the worst offenders, overall use of pesticides has increased leaving the environment awash in low levels of pesticide residuals with difficult to assess biological and ecological effects.[712]

Industrial chemicals

With the exception of the polychlorinated biphenyls that were restricted by law under TSCA, the EPA has not been able to phase out one chemical of concern.[713] Since the passage of the Act, the EPA

[711] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.
[712] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.
[713] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.

has used its power to restrict the use of a dangerous chemical just five times. By requiring the least burdensome remedy and deference to any other statutory authorities, TSCA generates few protections even to those substances that present the most obvious risks. The federal Government Accounting Office has issued a string of reports critical of the EPA's implementation of TSCA, noting that the agency has published few rules for standardizing chemical tests, has been slow to require tests, has not made test results readily available, and has, over thirty years, made no more than four referrals of chemicals in need of regulation to other agencies.

The EPA estimates that under TSCA, some 36,000 new chemical pre-manufacture notices (PMNs) were reviewed between 1979 and 2003. By its own records, the EPA notes that 67 percent of PMNs contained no test data and 85 percent contained no human health data. Therefore, the agency makes assessments largely based on models that predict the hazards of a new chemical based on its similarity to other, better-studied chemicals and on negotiations with the applicant for more information. Only about 10 percent of the total number of PMNs reviewed has resulted in restrictions, additional testing, withdrawn submissions or denials.

The Interagency Testing Committee has used its testing rule authority to require testing of just 200 chemicals. Additional studies are conducted by academic centers and private laboratories, but there is no systematic means for collecting them or ensuring their quality. The continuing absence of this information is particularly problematic because, in practice, the lack of toxicity information for many chemicals is often treated as if it were evidence of their safety.

TSCA's "Chemical Data Reporting Rule" (formerly the inventory update rule) requires that chemical manufacturers or importers maintain records and prepare reports on chemicals and mixtures and adverse reactions. 2016 updates apply reporting to the 85,000 chemical substances on the TSCA Inventory. However, the general threshold for reporting applies to chemical manufacturers and importers of more than 25,000 pounds in any year of the four-year reporting period. The high production threshold for reporting means many small and specialty manufacturers are exempt from reporting. It could be quite a long time before a newly introduced chemical is added to the inventory and produced at a volume that would require reporting. Updates also require the EPA to designate chemical substances on the TSCA Chemical Substance Inventory as either "active" or "inactive" in U.S. commerce within the period 2006-2016 which will help inform the prioritization of chemicals for risk evaluation.

Confidentiality claims protect significant portions of the chemical information submitted to the EPA for approximately 17,000 of the 84,000 chemicals on the TSCA Inventory. Of the 20,400 chemicals added to the Inventory since 1979 as new chemicals, industry acted in 13,600 cases to protect the identity of chemicals as confidential business information.

Product safety

By statute, the CPSC is reactive. They wait until there is substantial evidence of harm before initiating regulation. CPSA weaknesses include having to wait for injuries to become public to take action and relying on industry to report hazards they identify on their own, which are often held back for years. CPSA often mines hospital emergency room data to identify cases of concern.

Though, when it does, it must obtain manufacturer approval before releasing information about hazards publicly.

In 1982, Congress pressured by business amended the CSPA and sharply limited the powers of the CSPC. For example, a Chronic Hazards Advisory Panel was established to advise the Commission respecting the chronic hazards of cancer, birth defects and gene mutations presented by consumer products. The Commission was prohibited from issuing any rules in these arenas without permission of industry advisors.[714] Budget cuts later limited remaining authority by reducing staff to less than half of what it had been in 1974. In recent years there weren't even enough commissioners appointed by the President to maintain a decision-making quorum.[715]

CPSC has tested very narrowly when driven to assess risk, however the standard is so high that few mandatory regulations have been issued, particularly after amendments limited authority. CPSC can only issue mandatory standards if it can prove substantial compliance by industry to voluntary standards would be inadequate to reduce risk.

While some powers and budget were restored in 2008 amendments, two 2014 reports from the Government Accountability Office found the CPSC lacks efficiency and has significant challenges identifying and assessing new and emerging consumer product risks. The timeliness of the CPSC's responses may be affected by several factors, the report states, including compliance actions that can involve litigation, reliance on voluntary standards, rulemaking procedures, restrictions on sharing information with the public and international agencies, and limited agency resources.[716] "Oversight of consumer product safety is fragmented across agencies, and jurisdiction overlaps or is unclear for certain products. In some cases, agencies regulate different components of or carry out different regulatory activities for the same product, or jurisdiction for a product can change depending on where or how it is used. For example, NHTSA regulates hand-held infant carriers when used as car seats, but CPSC regulates the carriers when used outside of motor vehicles."[717]

CPSC must defer to a voluntary standard if it determines that compliance with a voluntary standard would eliminate or adequately reduce the risk of injury and there is likely to be substantial compliance with the voluntary standard. However, because the laws do not establish a time frame for finalizing a voluntary standard, conflicting industry and consumer interests can delay its development, sometimes for years.[718] The volunteer standard is so high that few mandatory regulations have been issued, particularly after amendments limited authority.

Clean air

The EPA reports the following pollution reductions since 1970:[719]

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[714] "H.R.3745 - Consumer Product Safety Amendments of 1981." U.S. Congress, 1 Jun. 1981, https://www.congress.gov/bill/97th-congress/house-bill/3745.

[715] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.

[716] "Challenges and Options for Responding to New and Emerging Risks." *GAO Highlights*, Nov. 2014, https://www.gao.gov/assets/670/666487.pdf.

[717] "Opportunities Exist to Strengthen Coordination and Increase Efficiencies and Effectiveness." *GAO Highlights*, Oct. 2014, https://www.gao.gov/assets/670/667040.pdf.

[718] Ibid. "Opportunities Exist to Strengthen Coordination and Increase Efficiencies and Effectiveness." *GAO Highlights.*

[719] Ibid. "The Plain English Guide to the Clean Air Act." EPA Office of Air Quality Planning and Standards, p. 2.

- Six common air pollutants have decreased by more than 50 percent,
- Air toxics from large industrial sources (i.e. chemical plants, petroleum refineries, and paper mills) have decreased almost 70 percent,
- New cars are 90 percent cleaner,
- Production of most ozone depleting chemicals has ceased.

Despite acknowledgement of significant advances, significant gaps remain in policy, management, monitoring, and enforcement. In a 2017 policy statement the American Public Health Association strongly states, "The U.S. Environmental Protection Agency (EPA) should aggressively address localized exposures to hazardous air pollutants and provide leadership in implementing innovative miniaturized monitoring technologies that promise to change the paradigm for air quality exposure assessment in the United States."[720]

The EPA's own Air Quality Management Subcommittee advises the agency to engage in a more holistic approach to air quality management. "Air quality management, in addition to addressing the lingering nonattainment problems for ozone and PM, and air toxics problems, should include consideration of the interplay between air quality objectives and other policies such as national land use, energy, transportation, and climate."[721] The subcommittee acknowledges that air quality, land use, transportation, energy, and many other programs and goals are both intertwined, mutually influencing each other and potentially in conflict. They assert, "Where possible, the AQM Subcommittee recommends that these programs be better aligned and function more effectively."[722]

In 2007, the Subcommittee specifically recommended the EPA:[723]

- Develop multipollutant regulations
- Adopt comprehensive framework and principles
- Improve data collection, priority setting and accountability
- Encourage prevention and incentivize innovation
- Reduce public demand for pollution generating activities
- Engage in broad, iterative process that would reflect significant interaction between all jurisdictional stakeholders and the full range of affected parties
- Coordinate and integrate planning with adjacent systems

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[720] "Public Health Opportunities to Address the Health Effects of Air Pollution." American Public Health Association, 7 Nov. 2017, https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2018/01/18/public-health-opportunities-to-address-the-health-effects-of-air-pollution.
[721] "Recommendations to the Clean Air Act Advisory Committee: Air Quality Management Subcommittee Phase II Recommendations." June 2007, p. 12, https://www.epa.gov/sites/production/files/2014-10/documents/phase2finalrept2007.pdf.
[722] Ibid. "Recommendations to the Clean Air Act Advisory Committee..."
[723] Ibid. "Recommendations to the Clean Air Act Advisory Committee..."

But, a decade later in 2017, as the EPA initiates review of the first batch of 10 chemicals under TSCA, the agency "decided to exclude from its calculations any potential exposure caused by the substances' presence in the air, the ground or water,"[724] instead, focusing on potential harm from direct contact with chemicals in the workplace. The New York Times reports, "The approach means that the improper disposal of chemicals — leading to the contamination of drinking water, for instance — will often not be a factor in deciding whether to restrict or ban them."[725]

Clean water and safe drinking water

Clean water policy suffers from the same root cause challenges found in clean air regulation. Forty-five years after landmark environmental protection policies became law, almost half of the nation's waters are still "impaired," meaning they are too polluted to support their identified uses and cannot serve as sources of drinking water, recreational area, or support fish and wildlife.[726] "More than half of U.S. stream and river miles continue to violate water quality standards. Surveys of lakes, ponds and reservoirs indicated that about 70 percent were impaired (measured on a surface area basis), and a little more than 70 percent of the nation's coastlines, and 90 percent of the surveyed ocean and near coastal areas were also impaired."[727]

The reasons for the impairment vary by location; major sources are agriculture, industry and communities (typically through urban runoff). These nonpoint pollution sources are difficult to control through national regulatory programs.[728] In addition to policy gaps, enforcement under existing law is also a significant challenge. "In early 2003, EPA concluded that 25 percent of all major industrial dischargers were in "significant noncompliance" with their CWA permits."[729]

"Polluted runoff is the primary source of pollution nationally, with nutrients — nitrogen and phosphorus — from agriculture the largest problem nationally."[730] Despite nonpoint source pollution (including runoff from construction sites and roads) being the leading cause of water pollution today, the Clean Water Act does not directly address nonpoint source pollution nor many kinds of habitat modification.[731] "Nonpoint sources of pollution are not subject to CWA permits or other regulatory requirements under federal law. They are covered by state programs for the management of runoff, under Section 319 of the act."[732]

Also similar to other policy challenges, the Clean Water Act implementation suffers from political controversy over precise definitions making long-standing protections vulnerable. "The 1972

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[724] Lipton, Eric. "The Chemical Industry Scores a Big Win at the E.P.A." New York Times, 7 Jun. 2018, https://www.nytimes.com/2018/06/07/us/politics/epa-toxic-chemicals.html?rref=collection%2Ftimestopic%2FClean%20Air%20Act&action=click&contentCollection=timestopics&region=stream&module=stream_unit&version=latest&contentPlacement=10&pgtype=collection.
[725] Ibid. "The Chemical Industry Scores a Big Win at the E.P.A."
[726] Andreen, William L. and Shana Campbell Jones. "The Clean Water Act: A Blueprint for Reform." Center for Progressive Reform, White Paper #802, July 2008, p. 7.
[727] "National Summary of State Information, Water Quality Assessment and TMDL Information." EPA, https://ofmpub.epa.gov/waters10/attains_nation_cy.control.
[728] "Clean Water Act." Wikipedia, https://en.wikipedia.org/wiki/Clean_Water_Act#cite_note-11.
[729] Ibid. "The Clean Water Act…" Andreen & Jones, p. 7.
[730] Ibid. "The Clean Water Act…" Andreen & Jones.
[731] Ibid. "The Clean Water Act…" Andreen & Jones, p. 5.
[732] Ibid. "The Clean Water Act…" Andreen & Jones, p. 6.

statute frequently uses the term "navigable waters" but also defines the term as "waters of the United States, including the territorial seas."[733] The CWA applies to all waters with a "significant nexus" to "navigable waters," however, the phrase "significant nexus" remains open to judicial interpretation and considerable controversy. In early 2017, the President directed the EPA and the Army Corps of Engineers to review and rewrite the administration's "Clean Water Rule," to clarify the Waters of the United States (WOTUS) definition consistent with promoting economic growth and minimizing regulatory uncertainty.[734]

"The United States has no cohesive national water policy. In fact, the oversight of current water policy is shared by over sixty different agencies, and the last national water assessment undertaken in the United States occurred over forty years ago."[735] The core of the current policy problem is our failure to bridge the land-water interface and other artificial boundaries we've created.[736] Planning, without accountability, is not enough, because voluntary approaches do not achieve measurable results. The government must aggressively enforce the CWA if it is to work as designed.[737]

Former administrator for U.S. Environmental Protection Agency, William K. Reilly, provides detailed insight into the policy challenges:[738]

- Diverse federal agencies are responsible for different aspects of water. There is confusion over authority and agencies are not collaborating to any significant degree.
- Jealously guarded state-based prerogatives in water law in tension with smart, coherent federal approach to overall water management and regulation.
- Insufficient funds are allocated to protect and manage water resources.
- Legislative authorities governing water lack basic information on today's water realities and advances in scientific/technical understanding of problems and solutions.

The EPA's Drinking Water Action Plan calls out specific environmental justice consequences of water policy challenges. "Economically stressed and disadvantaged communities, and small drinking water systems, are facing disproportionate risks as a result of underinvestment in drinking water infrastructure and limited technical, financial, and/or managerial capacity."[739] The agency's most recent safe drinking water needs survey estimates an overall need for drinking water infrastructure in the next 20 years of $384 billion, in addition to the $271 billion needed for the nation's clean water infrastructure over the same period of time.[740]

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[733] "United States Clean Water Act (CWA)." Section 502 (7); 33 U.S.C. § 1362.

[734] Davenport, Coral. "Trump Plans to Begin E.P.A. Rollback With Order on Clean Water." *The New York Times*, 28 Feb. 2017, https://www.nytimes.com/2017/02/28/us/politics/trump-epa-clean-water-climate-change.html.

[735] Christian-Smith, Juliet. "A Twenty-First Century U.S. Water Policy." Abstract, https://www.researchgate.net/publication/227468368_A_Twenty-First_Century_US_Water_Policy.

[736] Ibid. "The Clean Water Act…" Andreen & Jones, p. 8.

[737] Ibid. "The Clean Water Act…" Andreen & Jones, p. 4.

[738] Christian-Smith, Juliet and Peter H. Glieck. "A Twenty-First Century U.S. Water Policy." *Oxford University Press*, 2012, p. Viii.

[739] Ibid. "Drinking Water Action Plan." Office of Water, EPA. p.iii.

[740] Ibid. "Drinking Water Action Plan." Office of Water, EPA.

In addition to underinvestment, water injustices within federal water policy that affect low-income communities and communities of color include:[741]

- Disproportionate water hazard burdens, ranging from lack of clean drinking water to higher exposure to fish contamination
- Legacies of discrimination in land-use planning and housing that perpetuate exposure to lead contamination in drinking water
- Inequalities in the enforcement of water-specific policies and regulations
- Gaps in existing water policy to address cumulative risks and impacts to low-income communities and communities of color
- Overlooked and ongoing exclusion of community voice in solutions-focused policy conversations

Hazardous waste

The Resource Conservation and Recovery Act (RCRA) focuses on controlling waste after it is generated. In the 1990s rules were implemented to add waste prevention, minimization, and encourage sustainable procurement. RCRA provisions apply to waste products defined as "hazardous waste" but not a material's qualities or impact on human health, which vary considerably under a variety of circumstances and concentrations.[742] The EPA determines what is hazardous waste using ambiguous and often difficult to apply characteristics including toxicity, persistence, degradability in nature and potential for accumulation in tissue.[743]

RCRA and the EPA use a convoluted method of classifying waste. Before a waste can be termed a hazardous waste, it must be a "solid waste." Anything that is not a "solid waste," therefore, cannot be a "hazardous waste" and a "hazardous waste" is one subcategory of "solid waste."[744] The Definition of Solid Waste (DSW) is extremely important to industry because it outlines what is and is not subject to regulations. Materials outside of the DSW are unregulated and may move freely,[745] meaning if a hazardous substance is not first determined to be a solid waste, its transportation, storage and treatment is not required to be tracked and monitored.

In 2008 and updated in 2015, the EPA published rules to address gaps related to recycling of hazardous materials. These included codifying "legitimate recycling," for verified recyclers, and creating exclusions for hazardous secondary material. A 2018 Final Rule eliminates one of the four factors of legitimate recycling established in 2008. Recyclers are no longer required to have similar or lower levels of hazardous constituents in their recycled products compared to existing similar products. This is controversial because rather than being minimized and contained, hazardous

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[741] Ibid. "A Twenty-First Century U.S. Water Policy." Christian-Smith and Glieck. Page 56.

[742] "An Analysis of Regulations Under the Resource Conservation and Recovery Act." *Journal of Urban and Contemporary Law*, Jan. 1983, p. 151, https://openscholarship.wustl.edu/cgi/viewcontent.cgi?article=1440&context=law_urbanlaw.

[743] Ibid. "An Analysis of Regulations Under the Resource Conservation and Recovery Act." Page 152.

[744] Ibid. "An Analysis of Regulations Under the Resource Conservation and Recovery Act." Page 151-154.

[745] "Definition of Solid Waste." Institute of Scrap Recycling Industries, Inc. http://www.isri.org/safety/environment/definition-of-solid-waste.

materials are recirculating in consumer markets with potential human and environmental exposures.

RCRA contains a Corrective Action requirement that facilities clean up hazardous releases in soil, groundwater, surface water and air at both permitted and non-permitted treatment, storage and disposal facilities. The EPA reports 4,000 facilities are believed to need corrective action by 2020.

RCRA's unique citizen-suit provision allows claims against facilities storing toxic substances in ways that create an "imminent and substantial endangerment to health or the environment." The growing documentation of climate change effects suggests that this imminence requirement is met by heightened risks from flooding, storm surges and other natural disasters related to global warming. Groups could use the provision of the law to compel facilities housing toxic substances to consider climate change impacts, especially to vulnerable communities, in their planning for the storage, handling, transportation and disposal.[746]

European Union chemicals policy

The following describes the European Union's chemicals policy in order to provide a contrast to that of the United States, and to show a similarly-scaled model of a more comprehensive approach to chemicals policy.

REACH (Evaluation, Authorisation and Restriction of Chemicals) is a European Union policy enacted in June 2007 that is overseen by the ECHA (European Chemicals Agency).[747] It is described as "a regulation of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances in order to reduce the number of tests on animals."

REACH is distinct from U.S. regulation (TSCA) because the requirement to report all substances is much more wide-reaching in the E.U.[748] Whereas in the U.S., TSCA has very few requirements for disclosure of chemicals used in various industry products and allows for a "confidentiality claim." For companies that submit the "confidentiality claim"[749] under TSCA, they are allowed to include a "structurally descriptive generic name" as a substitute for the chemical substance.[750] The confidentiality claim is in place because industry argues it is proprietary information and they want to keep it away from their competitors. However, by keeping these data confidential, there's little information available to state and local regulators to understand which harmful chemicals are in

[746] "RCRA as a Tool for Environmental Justice Communities and Others to Compel Climate Change Adaptation." *Harvard Law Review*, Jun. 8 2018. https://harvardlawreview.org/2018/06/rcra-as-a-tool-for-environmental-justice-communities-and-others-to-compel-climate-change-adaptation/.
[747] Ibid. "REACH." The European Commission.
[748] "REACH and TSCA distinctions." https://www.google.com/url?q=https://www.repository.law.indiana.edu/cgi/viewcontent.cgi?article%3D1441%26context%3Dfacpub&sa=D&ust=1531757481912000&usg=AFQjCNEvqgJjpDNxygdIuhcmmkYvQGJ5jQ.
[749] "TSCA confidentiality claim." https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/tsca-confidential-business-information.
[750] "TSCA reporting policies." https://www.epa.gov/tsca-inventory/tsca-inventory-policy-and-guidance.

products on the market.[751] REACH, on the other hand, has a robust data set that even U.S. regulators can use to understand chemical profiles (an interviewee from WA Ecology noted that they use the data from the REACH system when they can). Between the chemical profiles from REACH and the limited testing from TSCA, it leaves much to be desired in terms of understanding risk (hazard + exposure) of chemicals and products in the U.S. market. Local jurisdictions do not have the funding and laboratory resources necessary to test on a small scale. All combined, there is a serious dearth of usable data to substantiate regulation and action.

REACH also places the burden of proof on companies to comply with regulations. Companies must register their substances (and therefore work together with other companies registering the same substance) and identify the risks the substances could pose to consumers. The ECHA then evaluates the registered substances for compliance and assesses whether risks can be managed.

[751] Hogue, Cheryl. "Trade Secret Anxiety." *Chemical & Engineering News*. 4 April 2011, http://pubs.acs.org/cen/email/html/8914gov1.html?utm_source=notaguineapig&utm_medium=twitter&utm_campaign=social media.

CONCLUSION AND OPPORTUNITIES FOR ACTION

This Study gathers a large body of research that documents the presence of and serious health risks of chemicals of concern in consumer products, describes how communities of color and other marginalized groups experience disproportionate risks, and explores root causes of the problem along with opportunities for addressing it while creating a safer, more just economy.

Root causes and structural solutions

On the following pages are an illustration of key patterns, social structures, and thinking revealed in the literature and during stakeholder interviews that underlay the problem of disproportionate community health and environmental impacts from toxic chemicals in products (left side). On the right is an alternative set of patterns, structures and thinking that also emerged during this Study that are aimed at achieving structural change for health equity.

"Current dominant thinking" labels key ideas that have supported the system that currently exists with disparate health and environmental impacts from toxics in products. "New thinking" labels key contrasting ideas that support a transition to a future where a new outcome - health equity - is achieved. The label "new thinking" is not meant to imply that the ideas are particularly new, as many have a long history.

New ways of thinking are at the root of new approaches to ensure all people can enjoy their right to a safe and healthy environment.[752] Targeted Universalism is based on the idea that we all share the same social fabric, and as a society we share a responsibility for the collective good over individual well-being. Therefore the problems of one population, demographic, or community are the problems of all. Also included in the "new thinking" is the idea of Cumulative Risk, which reveals that the risks of chemicals are compounded by racism and other structural inequities.

Green chemistry shows that health and environmental burdens can be eliminated through innovation while in many cases generating more jobs for a given level of output.[753] The European Union's comprehensive chemicals policy REACH shows that strong regulation can reduce toxics in an economy of comparable scale to the U.S. with only marginal overall impact on its chemical industry's global competitiveness and at a cost estimated to be one sixtieth the value of potential benefits to human and environmental health calculated over 25 years.[754,755] A Circular Economy approach that integrates toxics reduction can reduce impacts throughout the life cycle of products.[756] Additional examples of the new thinking needed to be adopted at a larger scale are

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[752] "Framework Principles on Human Rights and The Environment." United Nations Human Rights Special Procedures, 2018, https://www.ohchr.org/Documents/Issues/Environment/SREnvironment/FrameworkPrinciplesUserFriendlyVersion.pdf.
[753] "The Economic Benefits of a Green Chemical Industry in the United States." Political Economy Research Institute (PERI) University of Massachusetts, Amherst, commissioned by BlueGreen Alliance, https://www.peri.umass.edu/fileadmin/pdf/other_publication_types/green_economics/Green_Chemistry_Report_FINAL.pdf.
[754] "Impacts of REACH and corresponding legislation governing the conditions for marketing and use of chemicals in different countries/regions on international competitiveness of EU industry, Final Report." European Commission, 2016. https://publications.europa.eu/en/publication-detail/-/publication/67415a33-aafe-11e6-aab7-01aa75ed71a1.
[755] "Commission General Report on the operation of REACH and review of certain elements." 2018. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:116:FIN.
[756] "What is a Circular Economy?" *Ellen MaCarthur Foundation*, 2017, https://www.ellenmacarthurfoundation.org/circular-economy/concept.

state policies in the U.S. that require informed substitution of whole classes of chemicals and that are built on the idea that risks are best reduced by removing hazards.[757]

Through this shift in thinking, through broad strategic alignment between industry, researchers, government and communities focused on the achievement of health equity through comprehensive policy with better and more transparent data and adequate funding for agencies and community partners, the chemicals problem can be turned around. As the demand for and production of chemicals for consumer products rises globally,[758] indeed the need for change is becoming increasingly urgent.

[757] "The Six Classes Approach to Reducing Chemical Harm, Healthier Products, Healthier People." Green Science Policy Institute, 2019, https://www.sixclasses.org/.

[758] Ibid. "UN report: Urgent action needed to tackle chemical pollution as global production is set to double by 2030." United Nations Environment.

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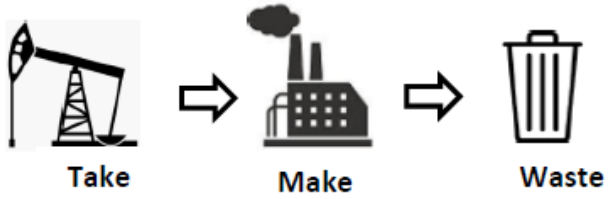
The chemicals problem, a systems view

EVENTS

PATTERNS



STRUCTURES

Communities bear structural inequities based on race, geography, etc.

Governments have fragmented, under-resourced regulations

Industry maintains outsized influence, forces health and environmental costs onto general public

Research serves toxic product production

CURRENT DOMINANT THINKING – *You are on your own*

Society is composed of individuals and businesses competing for resources in a system aimed at increasing productivity and profit. The benefits of chemicals outweigh their health and environmental impacts, the latter viewed as isolated and manageable, or unproven.

Health and environmental burdens are a price of progress

Strong regulations will hurt the economy and jobs

Chemicals presumed safe until proven harmful

The public should pay for proving the harm from chemicals

Individuals are responsible for choosing safer products

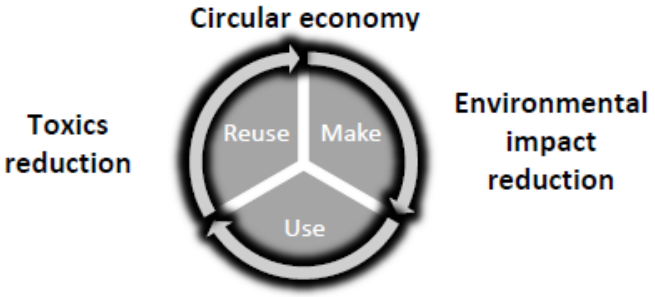
The dose makes the poison

Risks can be controlled by managing exposures to individual chemicals

A more equitable alternative

EVENTS

PATTERNS



STRUCTURES

All sectors align and collaborate on health equity, comprehensive policy

Communities lead efforts to identify solutions

Government convenes toxics reduction networks, regulates industry

Industry leads shift to green chemistry

Research and education advance green chemistry

NEW THINKING – *We are all in this together*

We all share the same social fabric, and as a society share a responsibility for the collective good over individual well-being. Risks of chemicals are compounded by racism and other social stressors, making multifactor consideration necessary to achieve a healthy future for everyone.

All people have a right to a safe and healthy environment

Strong regulations stimulate innovation, protect health and environment

Chemicals presumed harmful until proven safe

Industry should pay for proving the safety of chemicals

Industry is responsible for ensuring their products are safe

Very low doses are known to cause big problems

Hazards of whole classes of chemicals are best avoided by design

Opportunities for action and equity principles

The following opportunities for achieving toxics reduction and health equity emerged out of the rich history of chemicals policy reform efforts revealed in the literature and related research as well as through interviews with advocates, researchers, regulators and agency representatives involved in those efforts. The equity principles that precede the actions below were developed by the 2030 Regional Waste Plan equity work group, and adapted to this Study by replacing reference to the regional garbage and recycling system with reference to the chemicals production and consumption system. These principles guided the development of the 2030 Regional Waste Plan (RWP) and will continue to guide the implementation of that plan. These principles are also recommended for guiding implementation of this Study's opportunities for action for toxics reduction and equity.

Equity principles

Community restoration

Take action to repair past harms and disproportionate impacts caused by the chemicals production and consumption system. In practice, this means:

- Acknowledging historical impacts passed from generation to generation within communities.
- Actively including communities that have been historically marginalized from decision-making processes.
- Equitably distributing costs and benefits, taking into account historical and system impacts.
- Valuing indigenous and cultural knowledge about using resources sustainably.
- Committing to building a greater awareness of equity among public and private stakeholders involved in chemicals research, education and policy.

Community partnerships

Develop authentic partnerships and community trust to advance health equity through toxics reduction. In practice, this means:

- Prioritizing historically marginalized communities within the delivery of programs and services.
- Expanding voice and decision-making opportunities for communities of color.
- Supporting resilient community relationships by creating ongoing opportunities for leadership development.

Community investment

Emphasize resource allocation to communities of color and historically marginalized communities. In practice, this means:

- Making investment decisions in partnership with communities.
- Investing in impacted communities and youth through education and financial resources.

- Eliminating barriers to services and employment.[759]

Opportunities for action

The actions under Section A. *Advocate for and advance priority policies* below were generated during the development of - and are incorporated into - Metro's 2030 Regional Waste Plan. Sections B and C below are recommended for informing the development of the 2030 Regional Waste Plan implementation work plans. These opportunities and the broader findings of this Study are also meant to inform and inspire related efforts of other governments and stakeholders across sectors.

Many of these opportunities are general and require refinement in collaboration with local government and community partners. Resource constraints and the vastness and complexity of the problems of community impacts from chemicals in products also limit what can be done that could achieve a measurable impact by one community, organization, agency, region or state. Actions to be developed in pursuit of these opportunities should include a mix of those that will have a measurable positive impact at a community level in the short term, and those that advance a broader alignment of cross sector stakeholders to achieve systems-level changes over a longer timeframe.

A. Advocate for and advance policies and programs using a Targeted Universalism framework.

These include state and federal legislation and rulemaking as well as local government policies and programs with high likelihood of reducing health and environmental impacts on communities of color and health-vulnerable populations and advancing the establishment of a circular, low-carbon economy.

A-1. Advocate for legislation that minimizes chemicals of concern in products and packaging and requires the disclosure of product chemical data to consumers. *This is action 5.1 in the 2030 Regional Waste Plan.*

A-2. Assist the Oregon Health Authority in implementing the Toxic-Free Kids Act, which requires manufacturers of children's products sold in Oregon to report products containing high-priority chemicals of concern. *This is action 5.2 in the 2030 Regional Waste Plan.*

A-3. Partner with the State of Oregon to provide incentives to manufacturers for developing sustainable manufacturing techniques, including green chemistry, for products and packaging sold in Oregon. *This is action 5.3 in the 2030 Regional Waste Plan.*

A-4. Advocate for product stewardship legislation and other policy approaches that can achieve the greatest reduction in environmental and human health impacts from products and packaging made, used or disposed in the region. *This is action 5.4 in the 2030 Regional Waste Plan.*

A-5. Advocate for building products legislation to require those sold and used in Oregon to be free of highly toxic materials. *This is action 5.5 in the 2030 Regional Waste Plan.*

[759] Ibid. "2030 Regional Waste Plan…" Metro, March 2019.

A-6. Advocate for standards for high-impact products, including phase-outs or bans. *This is action 5.6 in the 2030 Regional Waste Plan.*

A-7. Implement strategies to increase the salvage of building materials for reuse, without increasing exposure to toxics. *This is action 8.2 in the 2030 Regional Waste Plan.*

A-8. Support implementation of Oregon Department of Environmental Quality's Reuse, Repair and Extended Product Lifespan Strategic Plan. *This is action 8.6 in the 2030 Regional Waste Plan.*

B. Conduct and support research and education on priority topics using a Cumulative Risk framework.

These include actions to address data gaps, advance policy and invest in community partnerships that build capacity.

B-1. Test products for compliance with current policies or for presence of unregulated chemicals of concern.

B-2. Track community health impact research for issues related to chemicals of concern in priority product categories.

B-3. Bio-monitor for priority chemicals in local communities and environments, ensuring transparency of results to community participants and a clear intention to use the data to advance health equity.

B-4. Track emerging toxics and green chemistry research related to local, state and broader safer chemicals goals, legislation and program initiatives, including innovations in materials management.

B-5. Support strategic education programming and communications that advance policy and skills development for community health impact reduction.

C. Convene cross-sector stakeholders for greater collective impact.

These actions focus on collaborations with community, local government, state, industry and nongovernmental organizations locally, nationally and internationally.

C-1. Identify common priorities and clarify roles across the multi-stakeholder spectrum, identifying gaps and overlaps and enabling mutually reinforcing efforts. Explore collaboration with new sectors and players including county health departments, culturally specific community organizations and industry.

C-2. Support the Interstate Chemicals Clearinghouse to convene, develop and advance strategies and tools for promoting safer chemicals and products with an equity focus.

C-3. Align political will around shared priorities.

C-4. Adopt a common lens to assess risk and inform priority-setting across agencies and stakeholders, using the Cumulative Risk framework as a model.

C-5. Align communications to amplify calls to action and promote best practices among stakeholders.

C-6. Support development of data resource hubs that advance safer-chemicals-related community health priorities. Consider including disproportionate health impacts, procurement policies, and strategic and tactical program and policy development information.

Metro's commitment to toxics reduction and equity

Metro is committed to working collaboratively with communities to advance toxics reduction and equity using its own authority and resources as well as through collaborations with local, state and federal governments, researchers and industry. Metro encourages others to use the findings in this Study to advance equity, toxics reduction and related systems-change work.

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APPENDIX 1: FEDERAL REGULATION HISTORY AND STRUCTURE

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Overview

The U.S. approach to managing toxic and hazardous chemicals relies heavily on government regulations and the ability to impose findings of financial liability on industry, rather than on industry incentives.[760] Policies fall into two general approaches: (1) subject protection intended to address safety by limiting hazardous exposure, and (2) chemical control established through placing restrictions or conditions on production, testing, use, and disposal of dangerous chemicals. Chemical control provides a protective gatekeeping function upstream. Subject protection manages

[760] Ibid. Geiser, Ken. *Chemicals Without Harm: Policies for a Sustainable World*.

the impacts of exposure downstream. The philosophical argument underlying regulation is that the most effective form of environmental protection focuses "on the pollutant rather than on the particular medium being polluted" and that regulating chemicals "before people are exposed" offers the best means to protect public health.[761]

By the 1940s, the low cost and high performance of synthetic and petrochemical compounds led to the development of materials that revolutionized the design and manufacture of industrial, agricultural and commercial products. Synthetics rapidly replaced conventional mineral-based and plant- and animal-derived chemicals in the product manufacturing markets. The result is chemical-industrial dependence and an ever-increasing chemical intensification of the economy.[762]

As evidence of adverse impacts began myth busting the "better living through chemistry" narrative put forward by industry, workers and consumers increasingly called for action. By the 1970s the federal government began stepping up to address the patchwork of state and local measures. Where environmental and occupational safety had once been the domain of states and industry, the push for national uniform laws led to the creation of the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), Clean Water Act, Safe Drinking Water Act, and the Resource Conservation and Recovery Act (RCRA).

Congress also began regulating chemicals in industrial products and processes through the Toxic Substances Control Act (TSCA) and the Consumer Product Safety Act (CPSA). Together these two laws form the basic structural framework of U.S. chemical control policy for materials and manufacturing. Toxic chemicals in food, drugs, medical devices, cosmetics and personal care products are primarily regulated under several federal laws administered by the FDA.

During the 1980s and most of the 1990s, the federal government largely ceased enacting regulatory statutes to protect public or environmental health. Beginning in the late 1990s there has been a resurgence of federal policy enhancements which picked up significantly during the Obama Administration. Notably, the Food Quality Protection Act (1996), the Consumer Product Safety Improvement Act (2008), FDA Food Safety Modernization Act (2011), and the Frank R. Lautenberg Chemical Safety for the 21st Century Act (2016). The changes move regulation in a positive direction, but they still fall short in terms of achieving health and environmental safety, coordinated implementation and funding for enforcement capacity.

Federal Food, Drug, and Cosmetic Act (FFDCA) of 1938, 1997

The Federal Food, Drug, and Cosmetic Act (FFDCA) authorizes the Food and Drug Administration (FDA) as a scientific, regulatory and public health agency that oversees items accounting for approximately 20 percent of consumer spending. Its jurisdiction encompasses most food products (other than meat and poultry), human and animal drugs, therapeutic agents of biological origin, medical devices, radiation-emitting products for consumer, medical, and occupational use, cosmetics and animal feed.[763] First established with a single chemist in 1927 within the Department of Agriculture, the FDA was transferred to the Federal Security Agency in 1940, and finally

[761] Ibid. Geiser, Ken. *Chemicals without Harm, Policies for a Sustainable World*. Page 25.
[762] Ibid. Geiser, Ken. *Chemicals without Harm, Policies for a Sustainable World*. Page 19.
[763] "FDA's Origin." FDA History Office, https://www.fda.gov/AboutFDA/History/FOrgsHistory/EvolvingPowers/ucm124403.htm.

established in 1988 as an agency within the Department of Health and Human Services, reflecting its public health focus.

The FDA sets the standards for manufacturer-mandated testing and data on drug effectiveness and safety. For prescription drugs the agency sets the conditions determining production processes, product labeling, product advertising, and managing special uses. For over the counter drugs, the FDA sets standards for acceptable ingredients, doses, formulations and labeling.

While the Food and Drug Administration regulates most aspects of food production and consumption in the United States, the EPA is responsible for regulating the use of pesticides on food. The EPA, in cooperation with the states, carefully regulates pesticides to ensure that their use does not compromise food safety.[764] The EPA sets tolerances for pesticides appearing in or on foods, the FDA is responsible for monitoring foods in interstate commerce and enforcing compliance with tolerances through its food inspection program. The **Center for Food Safety and Applied Nutrition** regulates chemical ingredients such as sweeteners, artificial flavors, colorants, preservatives used in processed foods and cosmetics labeling, as well as those in food contact materials.

The FFDCA requires premarket approval of new drugs, food additives, and coloring agents and authorizes standards for levels of pesticides, naturally occurring poisons, and toxic additives in or on food products. In addition, the law establishes standards for chemical content in various products and defines departures from those standards as adulteration or misbranding. Chemical additives to foods, drugs, or cosmetics are considered adulterations unless the FDA specifically approves their use based on the evidence of safety submitted by the manufacturer. In making such approvals, the agency may specify conditions of use, the amount of a chemical substance in a product, and any required product labeling.

Cosmetics are largely not subject to FDA regulations. Cosmetic manufacturers may use any ingredient unless the FDA proves it may be harmful.

The FDA's Center for Drug Evaluation and Research (CDER) regulates over-the-counter and prescription drugs, including biological therapeutics and generic drugs covered by the Federal Food, Drug, and Cosmetic Act. This work covers more than just medicines. For example, fluoride toothpaste, antiperspirants, dandruff shampoos and sunscreens are all considered "drugs."[765]

The Food Additives Amendment (FAA) of 1958 requires manufacturers of food additives to establish their safety. Chemical additives to foods, drugs or cosmetics are considered adulterations unless the FDA specifically approves their use based on safety test data submitted by the manufacturer. Additives must be certified as "generally recognized as safe" (GRAS) or approved for specific uses. In making such approvals, the agency may specify conditions of use, the amount of a chemical substance in a product, and any required product labeling. Determinations by the FDA on

[764] "U.S. Agencies Involved with Food Safety." *AG Law Text*, North Dakota State University, https://www.ndsu.edu/pubweb/~saxowsky/aglawtextbk/chapters/foodlaw/USagencies.html.
[765] Ibid. "About the Center for Drug Evaluation and Research." U.S. FDA.

the safety of chemicals in foods are based on test data submitted by manufacturers. However, all additives in use before 1958 are allowed without any testing or review.

The Food Safety Modernization Act of 2011 addressed the "food safety continuum" and granted the FDA new authorities to regulate the way foods are grown, harvested and processed, including mandatory recall authority. The law is intended to shift FDA focus to better protect public health by preventing food safety issues rather than reacting to outbreaks. "The law directs the FDA to promulgate a series of regulations to prevent unsafe food from entering the market and gives it more authority to act if problems are found. One of these regulations, requiring food manufacturers to conduct a formal hazards analysis and have written risk-based preventive controls to minimize these hazards."[766]

The Food and Drug Administration Modernization Act of 1997 added a streamlined pre-market Food Contact Notification Program to the previous required petition process within The FDA's Center for Food Safety and Applied Nutrition which regulates chemical ingredients such as sweeteners, artificial flavors, colorants, and preservatives used in processed foods. The program exempts food contact substances, indirect additives and direct food additives that manufacturers indicate will be present below threshold regulations. The threshold set is a dietary concentration at or below 0.5 PPB or 1.5 mg/person/day based on 3,000 grams daily of combined solid and liquid foods (1,500g each).[767] Also exempt from premarket notification and petition requirements are direct and indirect additives that are GRAS, or were in use prior to 1958.

The FDA has discretion to deny exemptions if information exists about public health risks. If the Food and Drug Administration receives significant new information that raises questions about the dietary concentration or the safety of a substance that the agency has exempted from regulation, the FDA may reevaluate the substance.[768]

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972 regulates testing, registering, labeling, sales, use, and disposal of pesticides, insecticides to herbicides, defoliants, fungicides and disinfectants to prevent "unreasonable adverse effects on human health or the environment."[769] In registration necessary for sale, EPA sets requirements for marketing, distribution, general or restricted use, and disposal of the pesticide. Registration is renewed every five years and may be cancelled or suspended if adverse human or environmental effects are found. The EPA sets tolerance levels for residues on food at a level that provides a "reasonable certainty of no harm" when considering all potential dietary and non-food exposures. Use and disposal is regulated through labeling. Most registered pesticides limit use to trained applicators regulated by state agencies.

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[766] Ibid. "Fixing the Oversight of Chemicals Added to Our Food." Pew Charitable Trust, p. 4.
[767] "Threshold of Regulation for Substances Used in Food-Contact Articles." *Legal Information Institute*, Cornell Law School, https://www.law.cornell.edu/cfr/text/21/170.39.
[768] Ibid. "Threshold of Regulation for Substances Used in Food-Contact Articles."
[769] Ibid. Geiser, Ken. *Chemicals without Harm, Policies for a Sustainable World*.

State and local delegating authority

The Oregon Department of Agriculture is the state delegating authority for FIFRA. ODA establishes licensing and labeling guidelines (outlined in *Urban pesticides*) and has a team of investigators around the state for any reported violations. If there are any pesticide violations that might fall under other agency purviews, the case is referred to the state's Pesticide Analytical Response Center which is a cross-agency mechanism for collaboration (other participants include OSHA, DEQ, Department of Health, and Department of Forestry).

There is no local or regional delegating authority. In fact, ORS 634.057[770] actually indicates state preemption of local laws.

Federal Food Quality Protection Act of 1996

The Federal Food Quality Protection Act (FQPA) of 1996 amends FIFRA and FFDCA to change EPA's regulation of pesticides. Creates a single, health-based standard "reasonable certainty of no harm" for all pesticide residues on food, with explicit attention to multiple exposures and risks to children and infants. It covers the combined residues from different pesticides and mixtures and incentivizes non-chemical crop protection and low hazard pesticides. The act required the EPA to develop a program to encourage safer pesticides and promote integrated pest management (IPM), a pest management approach that relies on ecological principles and discretely managed pesticide applications. As a result of requirement to review all existing tolerances within 10 years, EPA reassessed 9,721 pesticide tolerances and revoked or modified almost 4,000 tolerances.[771] Programs that were established are voluntary and not scaled to present serious alternatives to conventional pesticides. While this represents progress in the sense of reducing impact of the worst offenders, overall use of pesticides has increased leaving the environment awash in low levels of pesticide residuals with difficult to assess biological and ecological effects.[772]

Toxic Substances Control Act (TSCA) of 1976

Toxic Substances Control Act (TSCA) 1976 Regulates chemicals and chemical mixtures that may present "unreasonable risks of injury to health or the environment" through authority to inventory existing industrial chemicals, manage the introduction of new chemicals to the market, require health and environmental testing of substances of concern, and restrict the manufacture and use of the most hazardous chemicals. TSCA covers all industrial chemicals with exceptions for chemicals covered by other statutes such as pesticides and drugs.

New chemicals are reviewed by the New Chemicals Program for unreasonable risks in manufacturing process, disposal methods, and potential health and environmental effects of the substance. Environmental and health effects were balanced against the economic benefits of the commercialization of the chemical (product innovation and contribution to other industries) in the original statute but this was changed in 2016. EPA may ask manufacturers to conduct testing.

The Interagency Testing Committee (ITC) reviews existing chemicals and prioritizes up to 50 per year to a priority testing list. Where substances are found to present serious or widespread harm

[770] "ORS.634.057 - State Preemption of Local Pesticide Regulation." Oregon Laws, https://www.oregonlaws.org/ors/634.057.
[771] "Summary of the Food Quality Protection Act." U.S. EPA, https://www.epa.gov/laws-regulations/summary-food-quality-protection-act.
[772] Ibid. Geiser, Ken. *Chemicals without Harm, Policies for a Sustainable World*.

from cancer, gene mutations or birth defects, the EPA is required to take "appropriate regulatory action." The ITC is an independent advisory committee, created under TSCA to make recommendations to the Administrator of the EPA on prioritizing and selecting chemicals for testing or information reporting to meet the coordinated data needs of its 14 government member organizations.

Statutory members include: Consumer Product Safety Commission, Council on Environmental Quality, Department of Commerce, Environmental Protection Agency, Food and Drug Administration, National Cancer Institute, National Institute of Environmental Health Sciences, National Institute for Occupational Safety and Health, National Science Foundation, and Occupational Safety and Health Administration. Liaison members include: Agency for Toxic Substances and Disease Registry, Department of Defense, Department of the Interior, and U.S. Department of Agriculture.

TSCA's "Chemical Data Reporting Rule" (formerly the inventory update rule) requires that chemical manufacturers or importers maintain records and prepare reports on chemicals and mixtures and adverse reactions. The Rule, updated in 2016, applies to the 85,000 chemical substances on the TSCA Inventory. Polymers, chemicals imported in products and various impurities and byproducts are exempt. The general threshold for reporting applies to chemical manufacturers and importers of >25,000 pounds in any year of the four year reporting period. The production threshold for reporting means many small and specialty manufacturers are exempt from reporting. It could be quite a long time before a newly introduced chemical is added to the inventory and produced at a volume that would require reporting.

Frank R. Lautenberg Chemical Safety for the 21st Century Act of 2016

The Act was signed into law in June 2016. Passed with bipartisan support, the law changes assessment and management of chemicals under TSCA. The EPA's new authorities "include the power to determine unreasonable risk to health without having to trade it away for costs and other non-risk factors, as in a cost-benefit analysis; attention to vulnerable populations in risk determinations; once a determination of unreasonable risk is made, restrictions of the chemical must be made; deadlines set for all risk evaluations; from existing chemicals on the TSCA registry, the EPA must undertake required risk evaluations for each chemical it designates as a high-priority substance; companies must pay either 100 or 50 percent of the cost for evaluations of chemicals they request or that are on the EPA's Work Plan, respectively; the EPA is mandated to review and make a risk determination for all new chemicals; and the agency must make an affirmative finding about a new chemical before it can enter commerce."[773] Changes also include a new fast track process for persistent, bioaccumulative and toxic (PBT) chemicals and requirement that the EPA review business confidentiality claims. The legislation includes consistent funding for EPA to fulfill these responsibilities.

> Section 6 of the Toxic Substances Control Act (TSCA), as amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act, provides the EPA with the authority to prohibit or limit the manufacture, processing, distribution in commerce, use or disposal of a

[773] Ibid. "The Unsteady State and Inertia of Chemical Regulation Under the U.S. Toxic Substances Control Act." PLoS Biology.

chemical if the EPA evaluates the risk and concludes that the chemical presents an unreasonable risk to human health or the environment. The law authorizes the EPA to issue regulations requiring one or more of the following actions to the extent necessary so that the chemical substance no longer presents an unreasonable risk:

- Prohibit or otherwise restrict manufacture, processing, or distribution in commerce;
- Prohibit or otherwise restrict for a particular use or above a set concentration;
- Require minimum warnings and instructions with respect to use, distribution in commerce, or disposal;
- Require recordkeeping or testing;
- Prohibit or regulate any manner or method of commercial use;
- Prohibit or regulate any manner or method of disposal; and/or
- Direct manufacturers or processors to give notice of the unreasonable risk to distributors and replace or repurchase products if required.[774]

Imports of chemical substances, mixtures or articles that contain a chemical substance or mixture must comply with the Toxic Substances Control Act (TSCA) in order to enter the U.S. Importers must certify that imported chemical substances either comply with TSCA (positive certification) or are not subject to TSCA (negative certification). Certain chemicals are excluded and certain chemicals require no certification. The requirements are described in section 13 of the Toxic Substances Control Act (TSCA) (15 U.S.C. 2612).[775]

Of particular interest to Metro, the update clarifies and preserves states' ability to act on any chemical, or particular uses or risks from a chemical that the EPA has not yet addressed. It also allows states and federal government to co-enforce identical regulations.

State action on a chemical is preempted when the EPA finds (through a risk evaluation) that the chemical is safe or takes final action to address the chemical's risks. State action on a chemical is temporarily "paused" when EPA's risk evaluation on the chemical is underway, but lifted when EPA completes the risk evaluation or misses the deadline to complete the risk evaluation. States can apply for waivers from both general and "pause" preemption. If certain conditions are met, EPA may grant an exemption from general preemption.[776]

In June 2017, the EPA reported fulfilling its first year statutory responsibilities under the law. This includes finalizing rules establishing the process for evaluating high priority chemicals, defining scientific terms, and requirements for industry reporting which are retroactive 10 years. The EPA

[774] "Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act." Environmental Protection Agency, 7 Jan. 2019, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/regulation-chemicals-under-section-6a-toxic-substances.
[775] "TSCA Requirements for Importing Chemicals." Environmental Protection Agency, 7 Jan. 2019, https://www.epa.gov/tsca-import-export-requirements/tsca-requirements-importing-chemicals.
[776] Ibid. "Highlights of Key Provisions in the Frank R. Lautenberg Chemical Safety for the 21st Century Act." Environmental Protection Agency.

also issued guidance for submission of draft risk evaluations and released scoping documents for the first 10 chemical risk evaluations that will be conducted.[777]

However, "fulfilling the revised TSCA's mandates could take many years as the EPA would have to contract out or require companies to develop new tests to meet its risk assessment data needs. Without this basic information, the EPA cannot prioritize the tens of thousands of chemicals in commerce for a determination of relative risks. A Republican President and a Republican majority in Congress have leaned heavily toward diminishing the authority of the EPA, which means reducing its resources to carry out regulatory programs. Past experience shows that legal authority without the requisite resources is a recipe for inaction or glacial progress in public health regulations."[778] Case in point, 2017 appropriations cut the EPA's funding by $164 million and current levels are $1 billion less than President Obama requested in the TSCA rewrite.[779]

"The ultimate effectiveness of the revised TSCA in reviewing the chemicals in current use depends on the number of high-priority versus low-priority chemicals on the TSCA inventory of more than 85,000 chemicals that can be evaluated over a reasonable time period. The law requires the EPA to have 10 ongoing risk evaluations in the first 180 days and 20 within 3.5 years. Based on an assumption that it will have to undertake risk evaluations for 10 percent of the existing chemicals, or 8,500 in groups of 20 to be completed every 3.5 years, it would take about 1,500 years to complete. That is not a very encouraging outcome and mirrors the glacial pace of evaluating endocrine-disrupting chemicals. With a priority list of 500 chemicals a year and a 3-year completion time, the task could be completed in 50 years."[780]

Resource Conservation and Recovery Act (RCRA) of 1976

Resource Conservation and Recovery Act (RCRA) of 1976 regulates wastes which may cause or contribute to death or serious incapacitating illness or pose substantial present or potential hazards to human health or environment when improperly managed, treated, stored, transported or disposed. Congress intended the measures to ensure that all future hazardous waste disposal sites will be safely designed, that facilities currently in use are made to operate safely, and that previously used sites are cleaned up or "reworked" to prevent injury to surrounding areas.[781] The Act mandates waste minimization, recycling, and establishes permits and processing standards for waste management storage and processing facilities.

RCRA regulates "generators," the producers of hazardous waste and regulations apply to "sites," the locations where waste is generated. Generators, defined broadly, are responsible for tracking information and testing. They report by location, rather than company-wide, a policy requirement often criticized as unnecessarily complicated. The administrative burden of compliance reporting

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[777] "EPA Marks Chemical Safety Milestone on 1st Anniversary of Lautenberg Chemical Safety Act." U.S. EPA, https://www.epa.gov/newsreleases/epa-marks-chemical-safety-milestone-1st-anniversary-lautenberg-chemical-safety-act.
[778] Ibid. "The Unsteady State and Inertia of Chemical Regulation Under the U.S. Toxic Substances Control Act." PLoS Biology.
[779] "U.S. Chemical Regulations Finally Updated, Royal Society of Chemistry." Jun. 10 2016, https://www.chemistryworld.com/news/us-chemical-regulations-finally-updated/1010188.article.
[780] Ibid. "The Unsteady State and Inertia of Chemical Regulation Under the U.S. Toxic Substances Control Act." PLoS Biology.
[781] Ibid. "An Analysis of Regulations Under the Resource Conservation and Recovery Act." *Journal of Urban and Contemporary Law*.

applies based on quantities of waste generated which means only those reaching set thresholds are regulated. Generators may be regulated one month and excluded the next.

Historically recyclers (reclaiming materials for re-use or re-manufacture) have been excluded from regulations. Since 2008, efforts have been made to more clearly define legitimate recycling efforts. Expectations of recyclers have changed as recently as May 2018, in response to court rulings. Both industry and environmental advocates actively challenge interpretations of the Definition of Solid Waste in court, particularly as it applies to recycling. Advocates contend that hazardous waste is often exempted through processes that are not legitimate recycling, allowing generators to avoid the intent of RCRA.

Both federal and state governments implement and enforce RCRA. "For the majority of states having authorized state RCRA programs, those programs are required to be "equivalent to and at least as stringent" as the federal program."[782]

State and local regulatory mechanisms for RCRA

Oregon Department of Environmental Quality (DEQ) is delegated to implement the Resource Conservation and Recycling Act (RCRA) in Oregon.

Regarding local authority, there is no direct local delegating authority for RCRA. However, DEQ guides and enforces Oregon's solid waste statutes, approves local waste reduction plans and measures statewide progress towards goals.

Metro is delegated responsibility by Oregon statute for overall solid waste planning and management in the region. Metro develops and administers the Regional Waste Plan and shares responsibility with cities and counties for implementing the plan's actions. Metro is also responsible for ensuring that it and local governments meet statutory waste reduction program requirements. In addition to its programmatic work to reduce the impacts of products and their waste, Metro looks out for the public's interests by regulating privately owned garbage and recycling facilities. It also operates full-service waste transfer stations, provides collection services for household hazardous waste, operates a paint recycling facility and monitors and maintains a closed landfill in the region.

Cities and counties in Metro's jurisdiction manage the collection programs that provide recycling, yard debris, food waste and garbage collection services to single-family and multifamily residents and to businesses and institutions. They do not manage household hazardous waste, but instead Metro provides those services. Cities and counties do provide waste prevention, reuse and recycling education and technical assistance to support the collection programs and help residents and businesses reduce the environmental impacts of the products they buy, use and dispose. These activities must, at minimum, comply with state laws and the Regional Waste Plan. Counties also play a significant role in disaster event planning and response.

[782] "U.S. EPA Revises RCRA Definition of Solid Waste Rule to Comport with D.C. Circuit Rulings" *FreshLawBlog*, Jul. 10 2018, https://www.freshlawblog.com/2018/07/10/us-epa-revises-rcra-definition-of-solid-waste-rule-to-comport-with-d-c-circuit-rulings/.

There are elements under the Clean Water Act (which interfaces with RCRA) where there is some local authority implemented under the EPA's MS4 Permits to regulate discharge of pollutants into the stormwater management system.[783] See *MS4 Permits and the National Pretreatment Program* below.

Clean Air Acts of 1963 and 1970

Clean Air Acts of 1963 and 1970 regulate chemical air emissions and set limits on pollutants in the outdoor, or ambient, air throughout the US. The 1970 legislation established National Ambient Air Quality Standards (NAAQS) and required the EPA to identify and set standards for common pollutants identified as harmful to human health and the environment. The six "criteria pollutants" are: carbon monoxide, nitrogen oxides (from burning fossil fuels), ground-level ozone (smog), sulfur oxides, particulate matter (particle pollution), and lead.[784] The Act set primary standards to protect public health and secondary standards to prevent environmental and property damage, such as damage to farm crops and vegetation. Geographic areas where primary standards are met are referred to as attainment areas. When air quality does not meet the standard, areas are called nonattainment areas. "Despite continued improvements in air quality, millions of people live in areas with monitoring data measuring unhealthy levels of pollution."[785]

The law also required leaded gas to be phased out by the mid-1980s. The lead phase out is regarded by many to be one of the single most important and successful environmental health initiatives of the last century.[786]

Clean Air Act Amendments 1977, 1990

With many states failing to meet mandated targets, Congress adopted Clean Air Act amendments. Most notable for its effectiveness, is the New Source Review (NSR), which addresses industrial facilities grandfathered into the original law under the erroneous assumption that aging power plants and refineries would be phased out of production. New Source Review required big exempt polluters that wanted to expand to undergo an EPA assessment and install pollution control technologies or opt to offset increased emissions with reductions in other areas.[787] Results show priority air pollutants have declined in the last 30 years. However approximately 111 million people nationwide lived in counties with pollution levels above the primary NAAQS in 2017.[788]

The 1990 Additional Amendments include acid rain control and the prohibition of leaded gasoline in motor vehicles by the end of 1995. Regarded as an innovative approach toward curbing sulfur dioxides (SO_2) and nitrogen oxides (NOx), the two main sources of acid rain, the new provisions offered companies an array of choices in compliance methods to meet standard annual emissions

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[783] "Final Municipal Separate Storm Sewer System (MS4) General Permit Remand Rule." U.S. EPA, Nov. 17 2016, https://www.epa.gov/sites/production/files/2016-11/documents/final_rule_fact_sheet_508.pdf.
[784] Ibid. "Final Municipal Separate Storm Sewer System (MS4) General Permit Remand Rule." p. 4
[785] Ibid. "Final Municipal Separate Storm Sewer System (MS4) General Permit Remand Rule." p.5.
[786] Gilberta, Steven G. and Bernard Weiss "A rationale for lowering the blood lead action level from 10 to 2 µg/dL." *Neurotoxicology*. Sep 2006; 27(5): 693–701, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2212280/.
[787] Rowell, Erica. "Clean Air Act Timeline."http://www.acslpa.org/About-us/History-Of-The-ACSL/Clean-Air-Act-Timeline/clean-air-act-timeline.html.
[788] "Air Quality - National Summary." EPA, https://www.epa.gov/air-trends/air-quality-national-summary.

allowance limits.[789] The 1990 amendments also give the EPA, for the first time, specific authority to regulate emissions from non-road engines and vehicles, include fuel provisions requiring oxygenated gasoline be sold in areas that do not meet air quality standards and reformulated gasoline (reduces emissions of "air toxics") be sold in the nine worst areas that do not meet the minimum national air quality standards for Ozone.[790]

Before the 1990 Clean Air Act Amendments, the EPA regulated air toxics one chemical at a time—an approach that did not work well. The new approach encouraged flexible compliance approaches to spur business technology innovations that would clean-up air pollution as efficiently and inexpensively as possible.[791] The Amendments required the EPA to identify categories of industrial sources for 187 listed toxic air pollutants and to take steps to reduce pollution by requiring controls or changes to production processes at the source.[792] The EPA does not typically mandate a specific control technology, but "sets a performance level based on a technology or other practices already used by the better-controlled and lower emitting sources in an industry."[793]

The 1990 law established the Chemical Safety Board as an independent agency to investigate and report on accidental releases of toxic chemicals from industrial facilities and strengthened EPA's power to enforce the Act, increasing the range of civil and criminal sanctions available.[794]

While the laws are many and complex, a few more recent updates stand out as relevant to this Study. In 1997, the EPA updated limits on airborne particles from 10 to 2.5 micrometers. Additional controls are required on a variety of sources such as power plants and diesel trucks to meet standards.[795] In 1998, the EPA issued a rule limiting VOC emissions from consumer products. It requires many United States manufacturers, importers, and distributors to limit the VOC content of their products.[796] 2005 changes require the EPA to establish a national renewable fuel program designed to significantly increase the volume of renewable fuel that is blended into gasoline and diesel.[797]

Clean Air Act rollbacks in 2002, 2003

Thirty two years after the Clean Air Act became law, President George W. Bush's administration announced significant rollbacks to New Source Review pollution control provisions. Changes included allowing companies to avoid updating emission controls if their plant's equipment has been reviewed at any time within the past decade. Measures used to calculate emissions levels were reconfigured, and the permitting process built into NSR was drastically scaled back, eliminating EPA review and public comment when facilities wanted to expand their production, thereby

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[789] Timeline of Major Accomplishments in Transportation, Air Pollution, and Climate Change, EPA, https://www.epa.gov/transportation-air-pollution-and-climate-change/timeline-major-accomplishments-transportation-air.
[790] "Evolution of the Clean Air Act." EPA, https://www.epa.gov/clean-air-act-overview/evolution-clean-air-act.
[791] Ibid. "The Plain English Guide to the Clean Air Act." p. 15.
[792] Ibid. "The Plain English Guide to the Clean Air Act." p. 16.
[793] Ibid. "The Plain English Guide to the Clean Air Act." p. 17.
[794] Ibid. "The Plain English Guide to the Clean Air Act." P. 19.
[795] Ibid. "The Plain English Guide to the Clean Air Act." p. 5.
[796] Ibid. "The Plain English Guide to the Clean Air Act." p. 6.
[797] "Overview for Renewable Fuel Standard." EPA, https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard.

increasing their emissions. Changes limited community awareness of air quality and citizen oversight of EPA enforcement.[798]

State and local regulatory mechanisms

States have to develop EPA approved State Implementation Plans (SIPs) that outline how each state will control air pollution under the Clean Air Act and use regulations, programs and policies to clean up polluted areas. Individual states or tribes may have stronger air pollution laws, but they may not have weaker pollution limits than those set by EPA. The states must involve the public and industries through hearings and opportunities to comment on the development of each state plan.[799] If a plan does not meet the necessary requirements, the EPA can issue sanctions against the state and, if necessary, take over enforcing the Clean Air Act in that area.[800]

States and tribes issue operating permits to larger industrial and commercial sources that release pollutants into the air. Operating permits include information on which pollutants are being released, how much may be released, and what kinds of steps the source's owner or operator is required to take to reduce the pollution. Permit holders must measure and report on air pollution emitted.[801] State, local and tribal governments also monitor air quality, inspect facilities under their jurisdictions and enforce Clean Air Act regulations.[802]

The EPA assists state, tribal, and local agencies by providing research, expert studies, engineering designs, and funding to support clean air progress. The Clean Air Act provides for interstate commissions to develop regional strategies for cleaning up air pollution and requires the EPA to work with states to reduce the regional haze that affects visibility in 156 national parks and wilderness areas.[803]

Clean Water Act and Safe Drinking Water Act of 1972 and 1974

The EPA reports that contamination of drinking water supplies can occur in the source water or in the distribution system. Sources of water contamination include naturally occurring chemicals and minerals (arsenic, radon, uranium), local land use practices (fertilizers, pesticides, concentrated feeding operations), manufacturing processes, and sewer overflows or wastewater releases. Examples of health implications of water contamination are gastrointestinal illness, reproductive problems, and neurological disorders. Infants, young children, pregnant women, the elderly, and people whose immune systems are compromised may be especially susceptible to effects of contaminants.[804] Because Metro is interested in the safety of drinking water and the legislation is highly intertwined, this review includes both the Clean Water Act and Safe Drinking Water Act plus their significant updates.

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[798] Ibid. Rowell, Erica. "Clean Air Act Timeline."
[799] Ibid. "The Plain English Guide to the Clean Air Act." p.3.
[800] Frye, Russell S. "An Overview of the Clean Air Act." *EHS Today*, Apr. 29 2004, https://www.ehstoday.com/environment/air/ehs_imp_36973.
[801] Ibid. Frye, Russell S. "An Overview of the Clean Air Act."
[802] Ibid. "The Plain English Guide to the Clean Air Act." p.11.
[803] Ibid. "The Plain English Guide to the Clean Air Act."
[804] "The Effects: Human Health, Nutrient Pollution." U.S. Environmental Protection Agency, https://www.epa.gov/nutrientpollution/effects-human-health.

The EPA's Office of Water (OW) is responsible for implementing the Clean Water Act and Safe Drinking Water Act, and portions of several other statutes. Their mission is to ensure drinking water is safe, restore and maintain oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants and wildlife. The OW provides guidance, specifies scientific methods and data collection requirements, performs oversight and facilitates communication among those involved.[805]

[The authors note that many basic information pages on this topic, particularly related to drinking water are currently unavailable or "redirected" from the EPA's website—a striking contrast to the availability of similar information accessed on all other topics in this report. Additionally, this is the first policy arena in which we found agency documents actively naming disparate impacts as policy gaps to be addressed.]

The Clean Water Act of 1972

The Clean Water Act (CWA) established the basic structure for regulating discharges of pollutants into U.S. water to restore and maintain the chemical, physical and biological integrity of the Nation's waters.[806] The act regulates quality standards for surface waters and made it illegal for industries or municipal facilities to discharge any pollutant from a point source (e.g. pipe or man-made ditch) into navigable waters without a permit.[807] The CWA "required all municipal and industrial wastewater to be treated before being discharged into waterways, increased federal assistance for municipal treatment plant construction, strengthened and streamlined enforcement, and expanded the federal role while retaining the responsibility of states for day-to-day implementation of the law." [808]

The CWA utilizes both water quality standards and technology-based limitations to protect water quality. Under this act, federal jurisdiction is broad, particularly regarding establishment of national standards for effluent limitations.[809] Water quality standards are standards for the overall quality based on water uses (e.g. recreation, water supply) and the maximum concentration of various pollutants. Technology-based effluent limitations are specific numerical limitations established by EPA through permits and placed on certain pollutants from certain sources.[810] The primary basis of enforcement is the concept that all discharges are unlawful until authorized. The law may be enforced by civil, criminal, and administrative provisions including citizen lawsuits.[811]

The law falls into a legislative category of technology forcing statutes because it demands achievement of abatement standards by deadlines established in the legislation. Industries were given until July 1, 1977, to install "best practicable control technology" (BPT) to clean up waste discharges.[812] CWA also set higher goals be reached by 1989, generally requiring that industry use

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[805] "About the Office of Water." EPA, https://www.epa.gov/aboutepa/about-office-water.
[806] "Federal Water Pollution Control Act." 2002, https://docs.google.com/document/d/1CxuwUY8JWz2xzZ2-6FjBMPlcDCRm5Mb1WYUn71zP4FI/edit#.
[807] "Clean Water Act Summary." EPA, https://www.epa.gov/laws-regulations/summary-clean-water-act.
[808] "Clean Water Act: A Summary of the Law." *Congressional Research Service*, Oct. 2016, p.2, https://fas.org/sgp/crs/misc/RL30030.pdf.
[809] Ibid. "Clean Water Act: A Summary of the Law." p.4.
[810] Ibid. "Clean Water Act: A Summary of the Law." p.3.
[811] Ibid. "Clean Water Act: A Summary of the Law."
[812] Ibid. "Clean Water Act: A Summary of the Law." p. 2.

the "best available technology" (BAT) that is economically achievable. The primary focus of BPT was on controlling discharges of conventional biodegradable pollutants where BAT level controls focus on toxic substances.[813]

Water Quality Act Amendments 1987

Water Quality Act Amendments 1987 include regulation of nonpoint source pollution and prohibit discharge of oil and hazardous substances into U.S. waters. Development of management programs for ongoing pollutant problems was a critical element in amendments because of the ongoing nature of clean up after technological solutions have been applied.[814] The CWA includes special provisions related to any discharge of oil or hazardous substances because of the potentially catastrophic effects of such events on public health.[815]

The Clean Water Act does not directly address groundwater contamination. Groundwater protection provisions are included in the Safe Drinking Water Act, Resource Conservation and Recovery Act, and the Superfund Act.[816]

State and local regulatory mechanisms for the Clean Water Act

The CWA, like many other environmental laws, embodies a philosophy of federal-state partnership in which the federal government sets the agenda and standards for pollution abatement, while states carry out day-to-day activities of implementation and enforcement.[817] The act requires each state to establish water quality standards for all of its bodies of water.[818] In addition to the BPT and BAT national standards, states are required to implement control strategies for waters expected to remain polluted by toxic chemicals after industrial dischargers apply required cleanup technologies.[819]

The National Pollutant Discharge Elimination System (NPDES) delegates authority to state governments to perform many of the associated permitting, administrative, and enforcement aspects of the program.[820] States having primary responsibility. However, the EPA has oversight of state enforcement and "retains the right to bring a direct action where it believes that a state has failed to take timely and appropriate action or where a state or local agency requests EPA involvement."[821]

MS4 permits and the National Pretreament Program. MS4s are conveyance systems that are owned by states, cities, towns, or other public entities and designed to collect stormwater. They are not combined with sewers or publicly owned treatment works.

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[813] Ibid. "Clean Water Act: A Summary of the Law." p. 3.
[814] Ibid. "Clean Water Act: A Summary of the Law."
[815] Ibid. "Clean Water Act: A Summary of the Law." p.4.
[816] Ibid. "Clean Water Act." Wikipedia.
[817] Ibid. "Clean Water Act: A Summary of the Law." p.4.
[818] Ibid. "Clean Water Act: A Summary of the Law." p.3.
[819] Ibid. "Clean Water Act: A Summary of the Law."
[820] "National Pollutant Discharge Elimination System (NPDES)." https://www.epa.gov/npdes.
[821] Ibid. "Clean Water Act: A Summary of the Law." p.7.

Under MS4 permitting rules,[822] the City of Portland is required to do the following:

- Manage the 1200Z permits[823] to regulate industrial stormwater runoff per an agreement with Oregon DEQ. Under this agreement, The City of Portland has a Memorandum of Agreement[824] with DEQ to act as "agents" on behalf of DEQ for stormwater management under the Clean Water Act. Under this agreement, the city conducts inspections, and can take low-level enforcement actions (e.g. issuing a warning notice). However, in the case of non-compliance and a penalty needing to be issued, they defer to DEQ to refer an entity for action. They do not have the authority to take any action.
- Development of city code that protects the MS4 system.[825] The code essentially says that nothing can be dumped into the stormwater system. Per the code system, they follow up on spills and referrals from the spill complaint hotline. The inspectors are the same as those managing the 1200Z permits (see above). The goal is to attack any contaminations from all sides. The City of Portland has a blanket authority to enforce these codes.

Additionally, one area that comes close to a formal local delegating authority is through the National Pretreatment Program[826] which allows local municipalities to "perform permitting, administrative, and enforcement tasks for discharges into the municipalities' publicly owned treatment works (POTWs)." The program is designed to protect POTWs infrastructure and toxic pollutants from industries and other non-domestic wastewater sources. This is unrelated to the MS4 system.

Safe Drinking Water Act of 1974

The Safe Drinking Water Act (SDWA) was established to protect the quality of all waters actually or potentially designed for drinking use, whether from above ground or underground sources. The Act authorizes EPA to establish minimum standards to protect tap water and requires all owners or operators of public water systems to comply with these primary (health-related) standards.[827] The agency identifies contaminants and sets regulatory limits for the amounts of certain contaminants in water provided by public water systems.[828]

The National Primary Drinking Water Regulations (NPDWR) are legally enforceable primary standards and treatment techniques that apply to public water systems. The enforceable standards, called "maximum contaminant levels" (MCLs), establish the maximum allowable amount of a contaminant in drinking water to protect the public against consumption of drinking water contaminants that present a risk to human health. MCL Categories include microorganisms, disinfectants, disinfection byproducts, inorganic and organic chemicals and radionuclides.[829] A

[822] "Stormwater Rules and Notices." U.S. EPA, https://www.epa.gov/npdes/stormwater-rules-and-notices.
[823] "Industrial Stormwater Permits." U.S. EPA, 2018, https://www.oregon.gov/deq/wq/wqpermits/Pages/Stormwater-Industrial.aspx.
[824] "City of Portland Stormwater Program." Oregon Environmental Water Resource Group, Jun. 25 2014, http://www.oregonewrg.org/wp-content/uploads/2014/08/EWRG-Michael-Pronold-June-2014-Portland-MS4-Permit-and-Maintaining-Compliance.pdf.
[825] "Charter Codes and Policies." City of Portland, https://www.portlandoregon.gov/citycode/28181.
[826] "National Pretreatment Program." U.S. EPA, https://www.epa.gov/npdes/national-pretreatment-program.
[827] "Summary of the Safe Drinking Water Act." EPA, https://www.epa.gov/laws-regulations/summary-safe-drinking-water-act.
[828] "Drinking Water Contaminants – Standards and Regulations." EPA, https://www.epa.gov/dwstandardsregulations.
[829] "Secondary Drinking Water Standards: Guidance for Nuisance Chemicals." EPA, https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals.

complete table of contaminants, health effects from exposure, common sources and public health goals is available in the EPA's National Primary Drinking Water Regulations document.[830]

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding 15 contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color), or technical effects (corrosion or related staining) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply because contaminants are not considered to present a risk to human health, only a marketing risk in the eyes of the public who may "stop using water from their public water system even though the water is actually safe to drink."[831] However, some states may choose to adopt them as enforceable standards.[832]

Safe Drinking Water Act Amendments of 1996

The 1996 Safe Drinking Water Act Amendments require that the EPA consider a detailed risk and cost assessment, and best available peer-reviewed science, when developing primary and secondary standards. State governments, which can be approved to implement these rules for the EPA, also encourage attainment of secondary standards (nuisance-related). Under the Act, the EPA also established minimum standards for state programs to protect underground sources of drinking water from endangerment by underground injection of fluids.

The drinking water Contaminant Candidate List (CCL) is a list of contaminants that are currently not subject to any proposed or promulgated national primary drinking water regulations, but are known or anticipated to occur in public water systems. EPA uses the CCL to identify priority contaminants for regulatory information collection and decision making about future regulation. The SDWA requires EPA to publish the CCL every five years and directs the Agency to consider the health effects and occurrence information for unregulated contaminants as the Agency makes decisions to place contaminants on the list. SDWA further specifies that the Agency place those contaminants on the list that present the greatest public health concern related to exposure from drinking water.[833]

"When making a "determination" to regulate a contaminant in drinking water, the law requires that EPA determine whether it meets the following three criteria:

- The contaminant may have an adverse effect on the health of persons;
- The contaminant is known to occur or there is substantial likelihood the contaminant will occur in public water systems with a frequency and at levels of public health concern;

[830] "National Primary Drinking Water Regulations." Environmental Protection Agency, https://www.epa.gov/sites/production/files/2016-06/documents/npwdr_complete_table.pdf.
[831] Ibid. "National Primary Drinking Water Regulations."
[832] Ibid. "National Primary Drinking Water Regulations."
[833] "Basic Information on the CCL and Regulatory Determination." EPA, https://www.epa.gov/ccl/basic-information-ccl-and-regulatory-determination.

- In the sole judgment of the Administrator, regulation of the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems."[834]

The SDWA does not apply to bottled water which is regulated by the FDA, under the Federal Food, Drug, and Cosmetic Act. Federal quality standards for bottled water were first adopted in 1973 and must be compliant with EPA standards for tap water. There are regulations that focus specifically on bottled water, including "standard of identity" regulations that define different types of bottled water; "standard of quality" regulations that set maximum levels of contaminants allowed in bottled water; and "current good manufacturing practice" regulations that require production under safe and sanitary conditions.[835]

State and Local Regulatory Mechanisms for Safe Drinking Water Act

Oregon Drinking Water Services (DWS) administers and enforces drinking water quality standards for public water systems in the state of Oregon. DWS focuses resources in the areas of highest public health benefit and promotes voluntary compliance with state and federal drinking water standards. DWS also emphasizes prevention of contamination through source water protection, provides technical assistance to water systems and provides water system operator training.[836]

Wellhead Protection Programs "protect wellhead areas within their jurisdiction from contaminants which may have any adverse effect on the health of persons."[837] The principle agencies involved with the Wellhead Protection Program in Oregon are the DEQ and the OHA. The OHA has the responsibility of certifying the delineation to ensure that they have been accomplished within guidelines, assisting with development of the Water System's Contingency Plan, and planning for new groundwater sources. DEQ has responsibility for assisting in the water system's potential contaminant inventory and creation of management strategies. DEQ has the overall responsibility of certifying the community's wellhead protection plan.[838] DEQ and OHA encourage community-based protection and preventive management strategies to ensure that all public drinking water resources are kept safe from future contamination.

Consumer Product Safety Act (CPSA) of 1972

This act was designed to protect the public against unreasonable risks associated with consumer products, develop uniform safety standards for products, and study and prevent product-related illnesses and injuries. The law and the Commission preempted existing state product safety laws. CPSC is authorized to require cautionary labeling of hazardous household products that might cause personal injury or illness as a result of reasonably foreseeable handling, use, or ingestion. Hazardous substances may be banned or regulated where labels alone fail to provide sufficient protection and products intended for children may be banned for containing hazardous chemicals.

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[834] Ibid. "Basic Information on the CCL and Regulatory Determination."
[835] "Bottled Water Everywhere: Keeping it Safe." FDA, https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm203620.htm.
[836] "Oregon Drinking Water Services." Oregon Health Authority, https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/Pages/index.aspx.
[837] "Groundwater and Sourcewater Protection." Oregon Health Authority, https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/SOURCEWATER/Pages/whppsum.aspx.
[838] Ibid. "Groundwater and Sourcewater Protection."

Consumer Product Safety Improvement Act 2008
Driven by public demand for reform, the new legislation established independent testing for all children's products and requires supplier certification when products must meet standards. Amended again in 2011, the CPSC was given discretion in testing and ability to exempt previously manufactured children's products and toys under specific circumstances, e.g. resale of used items.

Consumer Product Safety Commission (CPSC) is an independent federal regulatory agency, created in 1972 by the Consumer Product Safety Act (CPSA). In addition to the CPSA, as amended by the Consumer Product Safety Improvement Act of 2008 (CPSIA), the CPSC also administers other laws, such as the Federal Hazardous Substances Act, the Flammable Fabrics Act, the Poison Prevention Packaging Act, the Refrigerator Safety Act, the Virginia Graeme Baker Pool and Spa Safety Act, the Children's Gasoline Burn Prevention Act, the Drywall Safety Act of 2012, and the Child Nicotine Poisoning Prevention Act. CPSC is headed by five commissioners nominated by the President and confirmed by the Senate for staggered seven-year terms. In 2017, CPSC had 567 FTE employees and their appropriation from Congress was $126 million.

The CPSC has jurisdiction over more than 15,000 types of consumer products used in and around the home, in recreation, and in schools, from children's toys to portable gas generators and toasters. However, large segments of the 15,000 products CPSC claims to oversee are excluded because they are under jurisdiction of other federal statutes.

The CPSA requires manufacturers or distributors of consumer products to immediately report to the CPSC when they obtain information which reasonably supports the conclusion that a product "contains a defect which could create a substantial product hazard," or "creates an unreasonable risk of serious injury or death. A "substantial product hazard" is defined as a product defect which "creates a substantial risk of injury to the public."

CPSC issues voluntary and mandatory standards, but primarily relies on industry associations to offer and negotiate standards that address product labeling, recall/repair of products, research on hazards, and distribution of consumer safety information. CPSC selects a product hazard for review based on public petitions, referrals from other agencies, congressional requests, or staff initiatives.

Occupational Safety and Health Act (OSHA) of 1970
Chemical hazards and toxic substances pose a wide range of health hazards (such as irritation, sensitization and carcinogenicity) and physical hazards (such as flammability, corrosion and explosibility). Exposures in the workplace are covered by the Occupational Health and Safety Act (OSHA) of 1970 designed to reduce workplace hazards and implement safety and health programs for both employers and their employees. The act created the Occupational Health and Safety Administration (also called OSHA) and the National Institute for Occupational Safety and Health (NIOSH).

OSH Act gives employees rights, including:

- get clear training and information in layman's terms on the hazards of their workplace, ways to avoid harm, and applicable OSHA standards and laws;

- access copies of any tests done to measure workplace hazards (e.g. chemical, air, and similar testing) and obtain and review documentation on work-related illnesses and injuries at the job site;
- confidentially make a complaint with OSHA to have an inspection of the workplace and not be discriminated or retaliated against.

Employers are obligated to:

- provide a safe workplace free of serious hazards;
- actively identify health and safety hazards and eliminate or minimize them; or provide employees with adequate safeguards and protective gear;
- notify employees of any hazards and provide the training necessary to address them;
- post a list of OSHA injuries and citations and maintain records of work-related injuries.

NIOSH is a federal agency responsible for conducting research in the field of occupational safety and health and making recommendations for the prevention of work-related injury and illness. NIOSH is charged with recommending occupational safety and health standards and describing exposure levels that are safe for various periods of employment, including but not limited to the exposures at which no worker will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience. NIOSH communicates recommended standards to regulatory agencies (including OSHA), health professionals in academic institutions, industry, organized labor, public interest groups, and others in the occupational safety and health community through criteria documents.

The traditional practice of worker protection is based on setting occupational exposure limits (OELs) for airborne contaminants. "Strict reliance upon sampling and analyzing airborne contaminants and comparing results with OELs has become increasingly difficult in recent decades because of the growing number of hazardous chemicals. The increasing number far outweighs the ability and resources—of government and other agencies external to chemical manufacturers—to determine associated OELs."[839] Also contributing to the increasing difficulty to protect worker health is the large variability in exposure measurements, both within and between workers.

"The majority of chemical substances in commerce have no established occupational exposure limits (OELs). Under OSHA these are called permissible exposure limit (PEL or OSHA PEL). PEL is a legal limit in the United States for exposure of an employee to a chemical substance or physical agent. In the absence of established PELs, employers and workers often lack the necessary guidance on the extent to which occupational exposures should be controlled."[840]

Ninety-five percent of OSHA's current PELs, only 30 of more than 500, have not been updated since their adoption in 1971. OSHA head from 2009-2017, Dr. David Michaels, notes that OSHA's current

[839] Ibid. "Qualitative Risk Characterization and Management of Occupational Hazards: Control Banding (CB)." Center for Disease Control NIOSH.
[840] Ibid. "Qualitative Risk Characterization and Management of Occupational Hazards: Control Banding (CB)." Center for Disease Control NIOSH.

PELs cover only a small fraction of the tens of thousands of chemicals used in American workplaces. "Many of our chemical exposure standards are dangerously out of date and do not adequately protect workers."[841] "OSHA recommends that employers consider using the alternative occupational exposure limits because the Agency believes that exposures above some of these alternative occupational exposure limits may be hazardous to workers, even when the exposure levels are in compliance with the relevant PELs."[842]

Substantial resources are required to issue new exposure limits or update existing workplace exposure limits. Courts have required complex analyses for each proposed PEL. Expensive economic and technical feasibility studies often take years to complete. Limited resources, incomplete data, and the ever-expanding inventory of chemical hazards in the workplace and global commerce make it infeasible to develop standards for all possible hazards. As a result, NIOSH has also been tasked with assessing and providing technical solutions and promising intervention strategies to protect the safety and health of workers.[843]

A qualitative strategy for assessing and managing hazards associated with chemical exposures in the workplace known as control banding may be used when there are no relevant PELs. "The goal of control banding is to match the hazard to the best control method possible to ultimately eliminate or reduce risk of accident and injury."[844]

The conceptual basis for control banding (CB) is the grouping of chemical exposures according to similar physical and chemical characteristics, intended use, and anticipated exposure scenarios. Based on these factors, appropriate risk management options are determined for each of these groupings and placed in a hierarchy of control strategies that (simplistically) resemble a hazard meter. A product with greater health hazards and higher exposure potential will have more stringent controls than a product with low health hazards that is unlikely to come in contact with or enter a worker's body. A key component of CB strategy is quick, accurate discernment of risk and appropriate action based on existing information accessible to workers in the field. "Control banding must be used in conjunction with health and safety practices such as substitution. Substitution for a less hazardous chemical is still highly recommended to prevent exposure. It is important to note that Control Banding is NOT a replacement for experts in occupational safety and health nor does it eliminate the need to perform exposure monitoring."[845]

"The utility of qualitative risk management strategies such as CB has been recognized by a number of international organizations." Different models, each with varying levels of complexity and applicability, are in use across various industries and regions. In the U.S. the method is targeted to small businesses where lack of information and training often results in unnecessary exposure. However, CB is not in widespread use in the U.S. or recommended for adoption by NIOSH because

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[841] "OSHA: Workers Are Not Being Protected From Chemical Hazards." EHS Today, Oct. 9 2014, https://www.ehstoday.com/safety/osha-workers-are-not-being-protected-chemical-hazards.
[842] "Permissible Exposure Limits – Annotated Tables." U.S. Department of Labor, https://www.osha.gov/dsg/annotated-pels/.
[843] Ibid. "Permissible Exposure Limits – Annotated Tables."
[844] "Control Banding." American Chemical Society, https://www.acs.org/content/acs/en/about/governance/committees/chemicalsafety/hazard-assessment/ways-to-conduct-hazard-assessment/control-banding.html.
[845] "Control Banding." NIOSH, https://www.cdc.gov/niosh/topics/ctrlbanding/.

additional development, evaluation, and discussion are required. In particular NIOSH identified "a critical need for a dynamic system that incorporates changing factors over time for both control implementation and managerial oversight."

Timeline of federal chemical policy and administration

1862 President Lincoln appoints first chemist to open the **Bureau of Chemistry** (pre-Food and Drug Administration) within the Department of Agriculture.

1906 Original **Food and Drugs Act** signed by President Roosevelt prohibits misbranded and adulterated foods, drinks, and drugs.

1910 **The Federal Insecticide Act** (FIA) ensured quality pesticides by protecting farmers and consumers from fraudulent and/or adulterated products by manufacturers and distributors.

1927 Reorganization of the Bureau of Chemistry creates the **Food and Drug Administration** as a regulatory agency. The Bureau of Chemistry continues to house nonregulatory research.

1938 **The Federal Food, Drug, and Cosmetic (FDC) Act** extends control to cosmetics and therapeutic devices, initiates drug safety and regulation, requires that new drugs show safety before selling, sets standards for food containers and safe tolerances for "unavoidable poisonous substances."

1940 **FDA** transferred from Department of Agriculture to Federal Security Agency.

1947 **Federal Environmental Pesticide Control Act** assigned the United States Department of Agriculture responsibility for regulating pesticides.

1948 **Federal Water Pollution Control Act** first major law addressing pollution.

1949 **FDA** publishes first guidance to industry, the "black book" **Procedures for the Appraisal of the Toxicity of Chemicals in Food**

1955 **National Air Pollution Control Act** provides funds for federal research of air pollution.

1958 **Food Additives Amendment** requires manufacturers of new food additives to establish safety; prohibits the approval of any food additive shown to induce cancer in humans or animals. FDA publishes the first list of 200 substances generally recognized as safe (GRAS).

1963 **Clean Air Act** established a federal program related to interstate air pollution transport within the Public Health Service and expanded research into techniques for monitoring and controlling air Pollution.

1965 **Federal Water Quality Act**

1966 **Fair Packaging and Labeling Act** requires all consumer products in interstate commerce to be honestly and informatively labeled, with FDA enforcing provisions on foods, drugs, cosmetics, and medical devices.

1969 **National Environmental Policy Act**

1970 **Environmental Protection Agency (EPA)** created by Executive Order of President Nixon.

Occupational Safety and Health Act created **OSHA** and **NIOSH**

Clean Air Act requires 90% reduction in emissions from new automobiles by 1975, establishes National Ambient Air Quality Standards (NAAQS) and requires **EPA** to set standards for pollutants identified as harmful to human health and the environment.

1972 **Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)** provides for federal regulation of pesticide distribution, sale, and use. Shifts emphasis to protection of the environment and public health

Consumer Product Safety Act established **Consumer Product Safety Commission (CPSC)** gives CPSC the power to develop safety standards and pursue recalls for products that present unreasonable or substantial risks of injury or death to consumers. Takes over programs pioneered by FDA under 1927 Caustic Poison Act, 1960 Federal Hazardous Substances Labeling Act, 1966 Child Protection Act, and accident prevention activities for safety of toys, appliances.

Federal Water Pollution Control Act Amendments (Clean Water Act) established basic structure for regulating pollutant discharges in to U.S. waters, gave **EPA** authority to control pollution, set wastewater standards, and require discharge permits.

1974 **Safe Drinking Water Act** requires **EPA** to establish standards for drinking water contaminants in water actually or potentially designed for drinking from above or underground sources.

1976 **Toxic Substances Control Act** allows **EPA** to assess and regulate introduction of new commercial chemicals and to regulate chemicals already existing in 1976 that posed an "unreasonable risk to health or to the environment." TSCA does not separate chemicals into categories of toxic and non-toxic. Prohibits the manufacture or importation of chemicals that are not on the TSCA Inventory.

1977 **Clean Air Act Amendment** set a schedule for continued reductions in auto emissions and established major permit review requirements to ensure air quality standards are maintained.

1982 **CPSC Amendments** roll back powers. FDA publishes first Red Book (successor to 1949 "black book"), officially known as Toxicological Principles for the Safety Assessment of Direct Food Additives and Color Additives Used in Food.

1987 **Water Quality Act** to include non-point source pollution and prohibit discharge of oil and hazardous substances into U.S. waters.

1988 **Food and Drug Administration Act** of 1988 officially establishes **FDA** as an agency of the Department of Health and Human Services with a Commissioner of Food and Drugs appointed by the President with the advice and consent of the Senate, and broadly spells out the responsibilities of the Secretary and the Commissioner for research, enforcement, education, and information.

1990 **Nutrition Labeling and Education Act** requires all packaged foods to bear nutrition labeling and all health claims for foods to be consistent with terms defined by the Secretary of Health and Human Services. The law preempts state requirements about food standards, nutrition labeling, and health claims and, for the first time, authorizes some health claims for foods.

Clean Air Act Amendment increased federal authority and responsibility; required further reductions in particular emissions and more stringent testing. Purview extended to control acid rain, ozone protection and emissions from non-road engines.

1992 **Residential Lead-Based Paint Hazard Reduction Act**

1996 **Food Quality Protection Act (FQPA)** passed unanimously by Congress. Amended FIFRA authorized EPA to strengthen the pesticide registration process by shifting the burden of proof to the chemical manufacturer, enforcing compliance against banned and unregistered products; mandated a health-based standard for pesticides used in foods, and provided special protections for babies and infants.

Safe Drinking Water Act Amendments require States to develop a Source Water Assessment Program for public water systems including surface water and groundwater sources.

1997 **Food and Drug Administration Modernization Act** mandates the most wide-ranging changes to agency practices since 1938. Provisions include measures to accelerate drug review from thirty to fifteen months, removes prohibition on marketing unapproved drug uses, eliminates pre-market approval for food contact substances.

2003 **The National Academy of Sciences** releases **"Scientific Criteria to Ensure Safe Food,"** commissioned by FDA and Department of Agriculture, which buttresses the value of the Hazard Analysis and Critical Control Point (HACCP) approach to food safety already in place at FDA and invokes the need for continued efforts to make food safety a vital part of public health.

2005* The **Green Chemistry Research and Development Acts** established the **Green Chemistry**

2007* **Research and Development Program**. Authorized appropriations for the National Science Foundation, National Institute of Standards and Technology, Department of Energy and EPA to invest in research and development.

2007 **Food and Drug Administration Amendments Act** allows the FDA to perform more comprehensive reviews of potential new drugs and devices, expanded clinical trial guidelines for pediatric drugs, and created the priority review voucher program.

2008 The **Consumer Product Safety Improvement Act.** Children's products defined and manufacturers and importers must comply with product safety rules, undergo testing, and certify compliance. Significantly increases the CPSC budget authorization.

2011 **FDA Food Safety Modernization Act** grants the FDA new authorities to regulate the way foods are grown, harvested and processed, including mandatory recall authority.

2016 **Frank R. Lautenberg Chemical Safety for the 21st Century Act** amends TSCA to include mandatory requirement to evaluate existing chemicals with clear and enforceable deadlines; fast track process for persistent, bioaccumulative, and toxic (PBT) Chemicals; risk-based chemical assessments for high-priority substances with special consideration to susceptible populations; increased public transparency for chemical information; requires affirmative finding on the safety of all new chemicals, requires review of business confidentiality claims; partially preserves states' ability to act but preempts certain authority, provides consistent funding for EPA.

*Two separate, closely related acts, often referenced together in research and reporting.

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APPENDIX 2: STAKEHOLDER PERSPECTIVES

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Stakeholders were asked "What will it take?"

What will it take to reduce, mitigate or eliminate chemicals of concern from consumer products? This was the primary question driving interviews with advocates, regulators, agency representatives, and researchers actively engaged in toxics reduction work. Crowd-sourcing the question of "what it will take" surfaced participants and roles, goals to strive for and strategies to build on. From this, one can begin to understand the system of activity and where some promising leverage points are. The interviews asked questions related to the purpose and roles of participants, jurisdictional capacity and authority, opportunities for emergent strategies, and current level of collaboration. Participants were interviewed using a baseline interview protocol.

Additional questions were asked based on the direction of the conversation and the unique expertise and perspectives of the participants.

A wide variety of opportunities for action emerged, and one thing common to nearly every interviewee was the value seen in convening advocates, regulators, researchers, and industry leaders at the same table to intentionally allow for jurisdictional and role specific influence, perspective and expertise to inform solutions generation at a systems scale. By convening key sectors and perspectives, solutions can be generated that outpace the speed of the federal government in public health protections.

Interviewees

Jennifer H. Allen, PhD, Associate Professor Of Public Administration, Portland State University
Jae P. Douglas, Ph.D., MSW, Environmental Health Services Director, Multnomah County Health Department
Jen Jackson, Toxics Reduction & Healthy Ecosystems Program Manager, San Francisco Department of Environment
Andrea Hamberg, Environmental Health Program Supervisor, Multnomah County Health Department
Scott Klag, Senior Solid Waste Planner, Metro
Kevin Masterson, Toxics Coordinator, Oregon Department of Environmental Quality
Tina Schaefer, Children's Safe Products Act Program Lead, Washington Department of Ecology
Kara Steward, PFAS Chemical Action Plan Coordinator, Washington Department of Ecology
Heather Trim, Executive Director, Zero Waste Washington
Kari Trumbull, Product Testing Chemist, Washington Department of Ecology
Ken Zarker, Pollution Prevention Section Manager, Washington Department of Ecology

Additional content provided by Metro project team members Carl Grimm and Lisa Heigh, as well as advocates who requested anonymity.

A system of four sector groups

The interviews surfaced four sector groups as essential for toxics reduction. These are advocacy (mostly non-governmental organizations), research (universities and others), government (local, regional, state, and federal), and industry (companies at any point in the supply chains). There are examples of how the entities are working independently or within their sector as well as when the need for collaboration is key to advancing particular initiatives. The following includes a summary of each sector's role and their "value-add" in the work.

Sector one: Advocates as catalysts

Advocates are essential for moving legislation and driving policy change, with one advocate noting, the "number one thing we do is get laws passed." For example, one Washington advocacy organization representative noted that a lot of the toxics legislation they've seen in Washington State was largely due to advocacy organizations, such as Toxics Free Future, and the lobbying that they've done. More so than amongst regulators, advocates pointed to the need and use of strategic thinking and planning to align efforts and leverage scarce resources. One advocate described their process for prioritizing legislative actions through a collaborative effort. They look for strategic opportunities that build on the political will of the moment while being sure to understand the

efforts underway in the area so as to reduce overlap. Interviewees from the regulating agencies observed that advocacy organizations are looking strategically at opportunities for legislation, how they impact public health, what risks there are, and the chances of getting legislation passed. They also noted that advocacy groups hold the ideal of the change, even when their influence is limited at the stage of legislation and rule making.

Advocates point to the partnerships with government as being key in successful passage of legislation. In some cases a regulatory body introduces a bill and the advocacy group responds with the road paved and primed for passage. This frees up government staff – who are largely unable to advocate – to work collaboratively with advocates and "tee" them up by cultivating the political will internally. That said, this is rarely the situation, and sometimes not the ideal. More commonly advocates are in the position of doing the cultivation themselves, building a cross sector coalition around the campaign, and then providing the lobbying through leveraging coalition resources. One advantage of advocates initiating legislation is that they are able to start out with a stronger bill than agencies are comfortable requesting. One advocate highlighted that the value of collaboration with agencies is the access to data such as local jurisdiction demographics as well as the credibility gained through legislative testimonies made by elected and agency officials.

Sector two: Researchers as supporters and innovators

Universities and other research groups have a vital role to play as relatively neutral, non-agency affiliated entities that can produce new data, analyze and synthesize existing data, substantiate claims and buttress advocacy and policy development. A broad array of research is needed to help advance equity in toxics reduction. The following are some examples of areas where research is particularly needed.

- Cumulative risk
- Biomonitoring
- Product testing
- Community health impacts
- Social determinants of health
- Chemical hazard assessment
- Alternatives assessment

Research is also an essential fuel for innovation. Indeed, every advancement in green chemistry comes from a lab somewhere. From the Lowell Center for Sustainable Development at University of Massachusetts to the Tyler Invention Greenhouse at University of Oregon, from the Green Policy Institute in Washington to the Carnegie-Mellon Center for Green Chemistry at Yale and to the labs at Nike, Columbia Sportswear and beyond, green chemistry is changing the makeup of products.

Sector three: Governments as conveners and coordinators

Generally speaking, the primary role of government agencies is thought to be implementing regulations. However, interviewees see government's potential for being an effective collaborative partner in moving toxics reduction forward via convening and coordination between stakeholders,

developing and distributing data, supporting strategic research and more. These activities can mobilize regional and national collaboration to increase the probability of impact on federal policies, as well as nationally scaled engagement with industry. Government – writ large – can do more to convene groups from different sectors working on specific issues to build bridges, to create understanding and to develop strategies for example to "nudge the EPA" to move in a particular direction. However, this is not to say regulation serves no function.

One interviewee shared their experience, "I worked on mercury containing lights program – the only way they [industry] would comply with anything was when it's within the law." Another noted "I don't think it should be at the customer level. These things shouldn't be on the shelves if there are [harmful] chemicals in there." And one way to motivate companies to change is simply through the law.

> "Us sending a letter to a company telling them that their information isn't in the children's safe products database isn't enough of a motivation for that company to change and take chemical "XYZ" out of their product. What does motivate industries to make a change is whether they're compliant or not with the law or whether their retailer that purchases their product to put on the shelf will let them sell their stuff. Speaking specifically about Walmart or Kroger or the big retailer saying "if you're not compliant, I'm not going to put your products on my shelf because the products I sell to my consumers have to be compliant." So the companies report."

One interviewee shared that industry is not in favor of a "patchwork approach that requires them to change for one distributor or retailer." Because of this, sometimes one or two states' laws can catalyze larger impacts on the market. Washington State passed a law to reduce the amount of copper in brake pad material (Better Brakes[846]) and eventually phased out copper in brake pads in Washington, giving industry time to find alternatives. California passed a similar law the same year (California Brake Pad Legislation).[847] What resulted was manufacturers coming together to create a new standard because they didn't want to create new pads solely for one state or a sprinkling of them across the country.

[846] "Better Brakes." Department of Ecology, State of Washington website. https://ecology.wa.gov/Waste-Toxics/Reducing-toxic-chemicals/Better-Brakes-law.
[847] "Limiting Copper in Brake Pads." California Department of Toxic Substances Control, https://dtsc.ca.gov/scp/limiting-copper-in-brake-pads/.

Oregon Department of Environmental Quality
The primary role of the Oregon Department of Environmental Quality (DEQ) is to implement and enforce statutes and regulations that control pollution. DEQ is the delegated authority by EPA to implement several federal statutes and rules designed to control toxic pollutant releases to the air, water and land. DEQ also implements and enforces state laws related to limiting toxics pollution, and develops rules to implement those laws.

Generally, states can establish more stringent pollutant standards and regulations than those established by EPA. One recent example of DEQ adopting regulations that are more restrictive than the federal requirements is for the control of air toxics from industrial sources that can have impacts on public health. The Cleaner Air Oregon rules were adopted in November, 2018 by the Oregon Environmental Quality Commission. The majority of DEQ's regulatory responsibilities focus on pollutants by industrial and municipal "point" sources, rather than on consumer products or other non-point sources. This regulation generally occurs at the point of generation or release into the environment (e.g., pipe, stack).

New opportunity in the Oregon legislature
There are two primary means of advancing toxics reduction in the state legislature – through new legislation and through the budget process. Particularly since the 2018 elections in Oregon and the Democratic supermajority in both houses, there is a unique opportunity for greater impact. One new piece of legislation that Metro is leading the charge for is HB 4126, Producer Responsibility for Household Hazardous Waste, which has gained support since it was first introduced as a concept bill in 2015. Other opportunities to explore include increasing funding for existing programs, agencies and functions that currently work on toxics reduction, for example at DEQ and Oregon Health Authority.

However, DEQ does have programs and initiatives focused on broader toxics reduction related to products. DEQ recently updated its Integrated Toxics Reduction Strategy that was first released in 2012 (see *Collaboration* section for more details). The intention of the strategy update according to one official is to help them "look ahead a little bit and identify what the needs are for environmental assessment and for the reduction of toxics and be able to drive the ship a bit more." The actions in the updated strategy are focused on complementing and supporting the agency's core regulatory programs, and filling gaps that are identified. Many of the actions emphasize "moving more upstream" to reduce toxic chemicals at the source, and working in collaboration with other agencies, organizations and states to achieve reduction goals. This Strategy is one vehicle for advancing safer chemistry and products in Oregon. One of the overarching principles within the 2018 Strategy is to incorporate Environmental Justice considerations into all of the proposed assessment and reduction actions.

In addition, DEQ's Materials Management Program develops and implements multiple sustainability, product stewardship and waste reduction projects that focus on consumer products. Materials Management Program staff are also integrally involved in the development and implementation of the agency's Integrated Toxics Reduction Strategy to ensure that the Materials Management Program's efforts address toxics reduction goals. This internal DEQ coordination

provides additional opportunities for Metro and other partners to collaborate on priority chemicals in consumer products.

Multnomah County Health Department and Office of Sustainability

Multnomah County Health Department

Multnomah County Health Department (MCHD) is guided by a set of strong values that determines their strategic and operational priorities within the context of what they are mandated to provide to the residents of the county. The commissioners and staff are aligned around the mission to focus on and prioritize populations that are made vulnerable through structural oppression; "we have support from all the directors, all the way to the top." One interviewee from the county described her work as where "environmental justice, science, policy and health come together." The MCHD sees themselves as "walking their talk" in terms of raising up and representing community voice due to their myriad of service delivery programs and clinics that provide them an "on the ground" perspective. As an example of this commitment, the health department is leading the charge of a county-wide environmental justice initiative that builds awareness around what environmental justice is, regardless of how distal the issues may seem to a particular role or department.

"One of great things of public health is that we don't have any internal conflicts to our mission… We are only here to protect public health. It's a very powerful lane and so we have to be careful how we use it."

However encompassing the charge may be to protect public health, to achieve it, they need to collaborate with other government entities. One MCHD interviewee added, "because we are government, we have a particular seat at the table when it comes to conversations going on with other government groups. So we use that when we can. Whether it's locally, at the state, or to testify." They have strong relationships with OHA and DEQ, which they leverage to create the "full suite of technical expertise" needed to address particular concerns when they arise and to develop strategies and initiatives to prevent adverse events. Given that several of the state agency headquarters are located in Portland, it makes collaboration easy, somewhat centralized, and also familiar. Additionally, because the county is comprised of several city level jurisdictions, effective collaboration at the intersection of each entity's authority is key to advancing joint goals.

The MCHD are trying to figure out where they can have the most impact given their jurisdictional authority (or lack thereof). Overall, they aren't able to regulate toxics in a meaningful way, but they are able to participate in conversations that are working towards reduction efforts. For example, the county commissioners were able to pass a wood smoke ordinance last year that allows the county authority to "call curtailment days" when the likelihood of excess wood smoke is high. Overall, the County recognizes their limits and opportunities as to how they can participate in toxics reduction as a government entity. With that, they also understand their power as the largest public health agency in the state and use it when they can to sway public and legislative opinion in support of public health.

Other bodies of MCHD's work include implementing aspects of the Safe Drinking Water Act via delegation by OHA with authority from EPA, and work relating to lead pipes that circulate drinking water. Note that this is different from implementation of the Clean Water Act, which is regulated largely by DEQ. MCHD does lead testing via a collaboration with the City of Portland wherein they monitor lead in homes via testing kits distributed by the county. They also do routine testing at county health clinics to screen for safe lead levels in children. If found, they go to homes and find the source of exposure. As part of their commitment to environmental justice, they are also researching fish consumption and identifying potential advisory group members to prepare for the cleanup of a superfund site. Once the clean-up begins, toxics will be stirred up and released via dredging of the river. Because of the diverse group of fishers, they are implementing strategies now to educate and inform them.

The county doesn't participate in the government related toxics reduction groups as mentioned by other government interviewees. Instead, they work with the National Association of County and City Health Officials (NACCHO) and its environmental public health tracking sub-committee.

Office of Sustainability

The MCHD collaborates internally with the Office of Sustainability, which has a very different role to play – essentially at the intersection of ecology and the environment. The Multnomah County Office of Sustainability's[848] vision is to work from a perspective of environmental justice to do the following.[849] They collaborate with community partners to advance policies, projects, programs and research that are responsive to the community's needs. They lead and support sustainability efforts within County departments and programs. They work with County leadership to advance this vision within the County, region and state.

Multnomah County Office of Sustainability (OS) has four function areas,[850] including the following:

- External policy: engages in research and works with various entities (e.g. external partners, county elected officials and Government Affairs, and community members) to create policies around sustainability (e.g. Climate Action Plan, Climate Preparation Plan, Air Toxics Policy, etc.)
- Internal policy: Similar to external policy, engages in research and works with internal stakeholders (e.g. elected officials, departmental leadership and employees) to create and implement internal policies to government agencies. Examples include a Green Building Policy, Sustainability Reporting, Sustainable Purchasing Policy and Toxics Reduction Policy).
- Build Capacity: Provide expertise in sustainability issues, connect resources across departments, provide policy support to elected officials and coordinate county-wide strategic initiatives. Examples of this include EcoChallenge, Bike More Challenge, Advisory Committee on Sustainability and Innovation, and Sustainability Liaisons Green Team.

[848] Multnomah County Office of Sustainability, https://multco.us/sustainability.
[849] A representative from the Office of Sustainability was not included in the interviews. These notes are from the website.
[850] Office of Sustainability function areas, https://multco.us/file/62157/download.

- Programs: Works directly with community members and partners to engage in environmental justice and restorative justice initiatives and other community projects happening in the community. Examples include summer internship programs, PropertyFit, Green Gresham and Gresham Healthy Tree Planting.

Sector four: Industry as innovator and maker

The most prevalent theme in all interviews was the crucial role of industry in changing the system of chemical production and consumption. In fact, one regulator stated that "for any policies to be effective, you need to understand the perspective and role of the manufacturers. Their compliance is going to be really limited if there isn't strategy that is feasible for them to adhere to." Another agreed, stating "the relationships I've formed with industry [have been] crucial and [have] helped tremendously and will help shape regulations going forward." This perspective was not universal. One advocate mentioned the threat of industry at the table. In fact, they wouldn't mention their current effort in fear of the details being printed and industry mounting a counter campaign to defeat their coalition. Strategic considerations are not just made by advocates. Initial attempts to interview a representative of one major brand that is a leader in toxics reduction work was prevented by their government affairs office. One interviewee noted that while the interests of governments, industry and advocates are not always aligned, the greatest success is likely to come when all parties understand each other better and build on their common ground. They added that "industry players are the architects and builders of the products upon which we all depend, and we are all clients in that relationship."

A Portland State University researcher who was interviewed recommended for anyone involved in regulation to consider the context from the industry's perspective, particularly: who uses the product, what it's used for, if there are alternatives and if there aren't alternatives, and to figure out what it will take to find those alternatives. An example from work they did with the World Bank on limiting ozone depleting substances was that it was actually fairly easy once industry was asked to look for alternatives. "[The industry] hadn't looked at alternatives," they said, "because they hadn't been asked to do it."

Sustainability as a driver of innovation

Some industry leaders in sustainability and toxics reduction describe their commitment to this work as a central driver for innovation and market competitiveness. Transitioning to green chemistry and away from controversial chemicals in the supply chain can also serve to make compliance with future regulation proactive, not reactive. Additionally, moving to safer chemistries helps to improve safety for workers throughout the supply chain, for the environment and for the public throughout the life cycle of the materials within products.

"Retail regulation"

Several interviewees focused on the power of business taking the reins and leading the charge on toxics reduction. They are able to move more quickly than government and have the power to strike fear of lost revenue in the hearts of their supply chain participants more starkly than government. Several large companies such as Walmart, Target, Costco, Patagonia and Nike are leading the pack in what interviewees refer to as "retail regulation." This refers to large retailers and businesses moving towards increased transparency in their product sourcing or institutional

departments, teams or initiatives to move towards reduced or, in some cases, zero toxics programs. Retailers have the power and potential to shift supply chain manufacturing of chemicals and their products substantially and at a scale that drives industry to change the chemical formulation of their products or to abandon problematic formulations altogether. From one interviewee:

> "When you start to look at the business sector, it does matter, it's going to affect the whole sector. And that's going to be more effective in getting to the people. That's why I've become more interested in how the business and industry can be partners in this process. Because if they flip, you've flipped it. Whereas, if we're just doing policy, we're trying to get them to do something different - pushing and pulling and poking and prodding and throwing a carrot in – so get them to flip! Make them part of the process. And if they'll flip, they'll flip. They don't want to use stuff that's harmful. I've never met anyone who's said "yes, I love toxics." But I have heard people say, "I have no alternative and I employ 80 people, tell me what you want me to do." I have heard people say that. But if you can say, "can we deploy some resources to find alternative products?" They say, "Sure, bring it on!"

When successful at getting a large retailer to "flip," (to green chemistry approaches) they have the power and scale to change the flow of the supply chain and require manufacturers to change the standard of practice.

Interviewees had different success stories of how industry shifted, but the common theme being driven by consumer demand first and their participation on cross sector collaborations (particularly with government) to facilitate their movement to phase out harmful chemicals and adopt green chemistry approaches. One interviewee was careful to make the distinction that industry has the challenge of creating products that offer the same conveniences, but in safer, non-harmful ways. For example, couches that don't burn but without the harmful chemicals.

Overall, interviewees were hopeful regarding business and industry. One person mentioned that their most gratifying moments in the work is when they "see the light bulb [turn] on about saving money and reducing pollution upstream." But to do this effectively, alternatives must be found at affordable costs.

The potential of procurement

Outside of "retail regulation," market demand from consumers, government and private procurement can shift markets but only if at a large enough scale and if contracts weigh environmental and social equity values high enough relative to monetary costs. The type of strategic alignment required for this high of an impact on the system of chemical production and consumption was a gap identified by several government interviewees. But the potential is large since industry doesn't like piecemeal approaches. They don't want to make small changes to their products for individual states, for example. It is more efficient and streamlined to adjust their products across the board. Interviewees offered several success stories discussed below.

And yet, despite the potential, many interviewees noted that there has been a lack of strategic coordination among government entities to catalyze broad changes in supply chains. State efforts

have been seen as random and uncoordinated, often disjointed, and piecemeal. There is an opportunity to improve this. And there are barriers. As one interviewee mentioned, "every state agency moves at a glacial pace. Walmart can put out a restricted chemical list with a signature from [the] CEO" and another mentioned that aligning political will among the various government departments is a challenge – everyone is moving at their own pace and often opportunities don't arise at the same time.

The following are some examples that one interviewee described as "the sweet spot" where either state or local laws or broad initiatives helped shift the manufacturing of products to be less toxic.

Polychlorinated biphenyl procurement policy in Washington State
Washington mandated that any products bought by state agencies had to be free of PCB's. This has prompted vendors to identify suppliers that can provide PCB-free products and to incentivize the suppliers to make the switch in order for the vendors to win large Washington state contracts. To increase impact, the existing coalitions across state lines could make even larger purchases and agree on product bans to encourage manufacturers to make permanent switches to their product inventory and to encourage changes up the supply chain.

Electronic Product Environmental Assessment Tool (EPEAT)
The leading global ecolabel for the IT sector, EPEAT, started as a task force on e-waste in Portland Oregon in 2004 by Zero Waste Alliance and comprised federal, state and local government and private purchasers, electronics manufacturers, recycling industry representatives, and advocates.[851] The group came up with strategies to effectively cut down on e-waste and redesign products to have a lower impact on the environment and be more easily and safely recyclable. The work modeled here by that task force rippled out across the country and the globe creating changes in the manufacturing of computers, chips and other electronic products related to computing that improves their environmental attributes, allows for their recycling and safer disposal.[852]

Collaboration

Emergent opportunities to improve collaboration
While many of the interviewees expressed the value of existing collaborations, there were a variety of gaps and opportunities expressed. The following are some of those observations and ideas.

"...while the interests of governments, industry and advocates are not always aligned, the greatest success is likely to come when all parties understand each other better and build on their common ground."

Collaboration (both inter-state and between state and local agencies) tends to be more on a person-to-person, comparing-notes basis. One example a local agency representative from California noted was reaching out to Seattle agencies to learn more about their policies around fluorinated chemicals in food ware and borrow some ideas on how they could

[851] "EPEAT: Electronic Product Environmental Assessment Tool - Development of an Environmental Rating System of Electronic Products for Governmental/Institutional Procurement." Institute for Electrical and Electronics Engineers, 2015, https://www.computer.org/csdl/proceedings/isee/2005/8910/00/01436980.pdf.
[852] "EPEAT." http://greenelectronicscouncil.org/epeat/epeat-overview/.

be applied locally. Building on this, interviewees shared that there aren't a lot of intentional strategies for cross-state policy alignment amongst regulatory agencies. While one state's laws can be a starting point to learn how to approach policy and borrow ideas for another state, there isn't a comprehensive coordinated effort to align those approaches. This came up in multiple interviews amongst implementers. One notable exception to the trend is the Interstate Chemicals Clearinghouse (IC2) which has been working to serve this function since 2010 with significant success, however as yet largely among a limited number of state and local governments. *See Interstate Chemicals Clearinghouse (IC2) below for more information.*

There are opportunities for states to collaborate around government procurement specifications for different products. This would actually make it easier on industries to have the same specs for multiple states rather than working with a different set of specs for each state. The local San Francisco Department of Environment representatives noted, "it drives industry crazy when it's different for each state. It would be easier for them to comply and shift" if states collaborated.

Regional agency convenings would be incredibly valuable but don't exist in any robust form at the moment. This was expressed by representatives from most of the government agencies. One Washington Ecology interviewee talked about the rare opportunities they've had to convene with other state representatives working on the same issues and noted "it would be better to sit at the table, break bread together… the west coast collaborative team bonds over Voodoo donuts. [That kind of interaction] makes a ton of difference." While there's great enthusiasm about it, there's an acknowledgement that there aren't logistical resources for such a convening at any one of the agencies and staff are already over-committed. A Washington Dept. of Ecology representative has often expressed an interest convening a PFAS summit; it's been difficult to figure out how to make that happen.

There are opportunities for regular information-sharing though they aren't as robust as the interviewees would like. While IC2 is referenced as being valuable, it's not enough. Current strategic planning at IC2 should be able to help address this need. There is also the Western Sustainability and Pollution Prevention Network (an alliance throughout EPA Region 9 – Arizona, California, Hawaii, Nevada, Trust Territories and Tribal Lands), but from a California representative was described as a "shadow of its old self."

Regulation tends to happen in silos which limits collaboration. Even though chemicals do not stay where they are applied and travel across mediums (for example from air to water to land), regulation is siloed to allow certain agencies to manage them. This separation, for example in the case of pesticide regulation in Oregon versus nearly all other toxic chemicals, leads to overall confusion and regulatory gaps. Unlike in many other states, the Oregon Department of Agriculture (ODA) regulates pesticides, while DEQ is responsible for most other chemicals. The DEQ representative interviewed saw this barrier to alignment and is working with ODA to address it.

Cleaner Air Oregon reform reflects the commitment of several agencies to make clean air a priority after the Bullseye Glass contaminants were revealed. That said, for all the good that has come out of that crisis, it doesn't address "the much bigger issues of diesel and particulates that are coming

from transportation corridors that aren't being dealt with. [We are the] dumping ground for dirty diesel because California and Washington have passed laws… we're a growing area. So our air quality is a concern."

Examples of scaled impact through collaboration

Interviewees expressed a desire for more opportunities to effect scaled impact through inter and intra-state and regional agencies working together more effectively on policy and regulation. Below are several examples.

States can learn from each other's legislation

Many interviewees mentioned how they learn from legislation passed in other states. They can borrow ideas or improve upon the initiatives that have gaps. One example of this is Oregon's Toxic-Free Kids Act. A representative from an Oregon advocacy organization discussed how they were able to look to Washington's Children's Safe Products law and see that it did a great job selecting chemicals of concern. Washington only required the industry to report the use of the chemicals not phase them out. Oregon adopted the same chemicals list, but took it a step further and created a ban on certain products containing the chemicals of concern if waivers are not granted.

Advocates collaborate with other organizations and agencies depending on the need

Collaborations are essential for advocacy organizations to promote legislation because they're often up against a lot of money from corporate interests and need to pool resources. One advocate interviewee said, "it's tricky to get [legislators] to do the right thing especially when there's a lot of opposition money around it." While advocacy organizations may have staff lobbyists or lobbyists within their coalition, the opposition undoubtedly has more as well as the implicit or explicit promise of campaign funding, which advocacy groups typically do not have. For this reason, they need a lot of stakeholders to partner up to advocate for legislation. Advocacy partners largely depend on the issue at hand. Often they partner with professional associations such as doctors, nurses, and firefighters, and other groups that are essential to make the case and show credibility. In the case of toxics, this is often health institutions such as Providence, Oregon Health Sciences University or others. They also work with the organizations that they consider their "very close allies" (Neighbors for Clean Air, Beyond Toxics, The Sierra Club, etc.) "that will actually do some of the work because no matter who has funding, it's always too much for one group to handle."

Advocates increase impact through aligned legislative priorities

One Washington state interviewee said collaboration is key to understanding what issue "has legs" and is worth pooling their resources on. Collaborations between advocacy organizations often depend on the topic and the behind-the-scenes legislative process. Advocacy organizations coordinate strategically across the nation to leverage impact by aligning policy priorities in several jurisdictions.

Toxics in Packaging Clearinghouse[853]

The Toxics in Packaging Clearinghouse (TPCH) maintains the "Model Toxics in Packaging Legislation"[854] developed by the Source Reduction Council of the Coalition of North East Governors

[853] "Toxics in Packaging Clearinghouse." https://toxicsinpackaging.org/.

- CONEG in 1989. The TPCH coordinates implementation of the legislation with its member states for the reduction of lead, mercury, cadmium and hexavalent chromium in packaging and packaging materials. Currently TPCH member states include Washington, California, Minnesota, Iowa, New York, New Jersey, New Hampshire, Connecticut and Rhode Island. The following states have legislation, but are not members of TPCH: Wisconsin, Illinois, Missouri, Maine, Vermont, Maryland, Pennsylvania, Virginia, Georgia and Florida. Interviewees from Washington's Department of Ecology discussed that their role in this work is to work with other states to test them for violations – products are sent to Washington for the testing – and if violations are found, a letter is sent to the company on behalf of the entire TPCH group, therefore increasing pressure and opportunity for scaled impact. Interviewees noted that it would be very beneficial for local jurisdictions to participate in the TPCH because they could participate in the product testing across the country, increasing accountability of manufacturers.

Oregon Toxic-Free Kids Act[855]

Passage of the Toxic-Free Kids Act was a huge success for Oregon and stakeholder collaboration as it was the second-strongest toxics ban in the country (after California's). The decade long effort to get the act passed was led by Oregon Environmental Council with support from a variety of stakeholders, including Metro, and ultimately with technical support from DEQ and the Oregon Health Authority who is now responsible for implementation.

The Interstate Chemicals Clearinghouse (IC2)[856]

The IC2 is an association of state, local and tribal governments working with industry, NGOs and Universities to promote safer chemicals and products for a clean environment, healthy communities and a vital economy. Metro and DEQ were two of the founding members and the group now includes a total of nine states, three local governments, two major retailers, nine NGOs and one University. Key accomplishments include advancing Alternatives Assessment methodologies and developing the High Priority Chemicals Data System database to serve the children's safe product disclosure programs of Oregon, Washington and Vermont. Several other databases serve safer chemicals programs and initiatives across the country, and trainings and networking help members improve effectiveness and efficiency through collaboration and coordination and improve the access and quality of chemicals data.

Despite the existence, goals and successes of the IC2, it is notable that all but one interviewee expressed in so many words that there is a vast unmet need for collaboration and coordination (of the kind offered by IC2). Clearly, there is an opportunity and a need for IC2 to better achieve its goals. One interviewee pointed out that fortunately, the group is presently in the process of developing a three-year strategic work plan to expand its reach and impact on the drive for safer chemicals.

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[854] "Model Toxics in Packaging Legislation." https://toxicsinpackaging.org/model-legislation/model/.

[855] "Toxics Free Kids Act." https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/TOXICSUBSTANCES/Pages/Toxic-Free-Kids.aspx.

[856] "Interstate Chemicals Clearinghouse (IC2) website." 18 Mar. 2019, http://theic2.org/.

BizNGO[857]

BizNGO came up in conversation about collaboration between business and environmental leaders as they are already a hub for collaboration. The organization (based out of Massachusetts) expresses a mission to "promote the creation and adoption of safer chemicals and sustainable materials, thereby creating market transitions to a healthy economy, healthy environment, and healthy people." Their annual meeting could be a place for discussions to take place (the 2018 meeting is in December in Berkeley, CA). Note, BizNGO only came up in one interview with the San Francisco agency representative, so it's uncertain whether other agencies are collaborating with this group.

Big Cities Health Coalition[858]

The Big Cities Health Coalition (BCHC) is "a forum for the leaders of America's largest metropolitan health departments to exchange strategies and jointly address issues to promote and protect the health and safety of the 55 million people they serve." One of the interviewees from OHA noted that they were a part of that group, specifically with the environmental justice committee. The coalition is largely focused on lead in a couple of ways: the water service delivery line (this isn't as much of an issue in Portland but they're looking at home systems) and refugee communities that move to communities with already high lead levels.

Integrated Toxics Reduction Strategy (Oregon DEQ)[859]

Launched in 2012 as a DEQ representative describes as "an attempt to work across our programs and across our regions to identify areas where we can better complement and support our core programs which are set forth by the Clean Air Act, Clean Water Act, CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act), and RCRA (Resource Conservation Recovery Act)." The actions outlined in the 2012 strategy that are related to improving integration and prioritization of toxics reduction activities included the following (note: there are other priorities in addition to those listed in the strategy, these are just specific to collaboration and integration across departments):

- DEQ programs will work together to address cross-media impacts of Focus List toxics, and to coordinate and integrate program requirements that address common objectives for Focus List chemicals.
- Integrating technical assistance across programs to advance green chemistry in two industry sectors and identify priority geographic areas for integrated toxics reduction technical assistance.
- Use existing rural planning and resource management programs to reduce loadings of Focus List toxics into Oregon water bodies through natural resource agency collaboration.
- Prioritize and direct efforts to meet new national ambient air quality standards and greenhouse gas reduction goals to maximize reductions in Focus List chemicals.

[857] "BizNGO." https://www.bizngo.org.
[858] "Big Cities Health Coalition." https://www.bizngo.org.
[859] "DEQ Integrated Toxics Reduction Strategy." https://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Reducing-Toxics.aspx.

According to our interview with a DEQ representative who manages and coordinates this process, they are working to formalize and institutionalize these action items. Part of that goal, as expressed by the interviewee, is to "formalize and institutionalize as a team rather than just checking in with them after it's adopted and when we get into implementation mode. So that's an action in our strategy. To institutionalize, go get our administrators on board to support having their people spending some of their time on that." One of the other goals of the updated strategy is to work with OHA more on messaging, in particular to "work on identifying where those major concerns are" and "be able to speak with one voice." *More details about this in the Strategic communications alignment gap section below.*

The Association of State and Territorial Solid Waste Management Officials (ASTSWMO)[860]
The national association that works with states on waste management policies, including hazardous waste. Washington Department of Ecology representatives are very active in this association.

Government agency information-sharing with local companies
The San Francisco agency representative mentioned that they participate in information-sharing meetings on a monthly basis with local companies (Google, Facebook, etc.) around procurement strategies. This could be valuable for cross-state, cross-region interactions as well because from those discussions, collaboration can emerge.

Gaps

Data gap

States are feeling very compelled to act. But local and state regulators are hard pressed to make data-driven decisions because there is so little data on the large majority of chemicals on the market. TSCA's data generation is slow (~85,000 chemicals total and they test 10 at a time) and local jurisdictions typically don't have the financial resources to test and understand impacts. Interviewees agree that it is both the EPA's job to test chemicals and distribute findings and that the EPA will not succeed in this in any meaningful way that will protect human health and the environment.

Several regulators and advocates turn to data from the European Union chemicals policy REACH (see details in the *Regulatory context* section) when in search of chemical and toxicity profiles because of their use of the precautionary principle in allowing chemicals and products on the market. REACH was referred to throughout nearly all of the interviews in one capacity or another. In this context, it's an example of how placing the burden of proof on industry generates more data versus the U.S. approach that generates little data and keeps much of it proprietary. "Not that REACH is perfect, I'm afraid. Basically the problem is that we need a reversal [to] give authority to state or feds to regulating chemicals and not being at [the] mercy of [industry] not providing the data." They added an example, "for fluorinated chemicals, the FluoroCouncil says 'there's so much data that says that these short-chains are safe,' and then wouldn't make the data public because it's proprietary. So of course, we don't believe them because it's probably not even true. So the problem is that we don't even have access to the information and data because we don't have a system that

[860] The Association of State and Territorial Solid Waste Management Officials (ASTSWMO), http://astswmo.org.

makes that required. So we just need to flip the equation" from "safe until proven unsafe" to "no data, no market," as REACH does.

Advocates also mentioned the need for lawsuits as a way to "force the government to provide more pathways to regulation because current laws are too weak." But in the absence of laws, lawsuits aren't helpful. There is a need for an aligned "watchdog" effort to ensure improvements in the laws. They cite the Federal Clean Air act as being one of the weakest laws that also has one of the biggest toxic impacts on human health yet the federal laws aren't in place to achieve that. So the hope is for policy with the breadth and depth of REACH to help regulate more effectively.

Funding and resources gap

As mentioned above, states have limited funds to support research and data development, such as robust (enough) monitoring and tracking systems to understand trends and make accurate projections that would support meaningful regulation. Another example is to incentivize non-traditional partners to be part of the toxics conversations. While cross-sector conversations are occurring fairly well in the Portland metropolitan area, they are slow to be established in other areas of the state due to limited funds to hire staff that can make the connections between the environment and health. This requires increased public health or other funds, as well as political will to prioritize this type of work.

Strategic communications alignment gap

"I do not believe plain old education does the trick."

Several interviewees brought up the need for an aligned, sophisticated cross-sector communications campaign that goes beyond public education. Two interviewees suggested using social marketing as a way to motivate behavior change. Another cautioned that "what is often overlooked is the very high cost of measurably effective social marketing and education work. To be effective, you need very specific goals and actions that measurably advance efforts to either get policies enacted, achieve widespread compliance with existing policies, or to motivate very specific behavior changes. Otherwise it wastes a whole lot of resources and time."

Interviewees suggested both a general toxics communications campaign as well as targeted chemical campaigns. For example, DEQ saw the value in generating a regional communications campaign to bolster the work of the regional agencies. This was contrasted by an advocate group in Washington that suggested communications campaigns around specific toxics or the products they are found in. We heard an example from San Francisco that they used social marketing techniques to teach residents about how to dispose batteries safely. There were previous events that pointed to their danger, so they didn't have to create a shared why or purpose to convince people that it was important to dispose properly. Instead they focused on educating and directing residents to very specific steps along with infrastructure support from the city. They are collecting data on compliance to measure the effort's impact. They used a variety of media to spread the word, including six planned events (that looked "organic") where people were drumming on the streets with the collection buckets. When someone took a video of it, they were able to hashtag and connect to the content to spread the word through social media. There were also staff present to talk to people and answer questions. "The idea was for people to get excited and maybe start taking video

and post that. And then we had staff there to talk with people who were watching. The message in song and on the banners all around them was 'put your batteries in the bucket or top it.'"

One interviewee who has participated in extensive social marketing training over the past ten years emphasizes the importance of strategic planning leading to pristine messaging.

> I do not believe that just plain old education does the trick at all. For decades we just tell people things and put up posters. That does not do the trick. It needs to be social marketing. So I firmly believe that the best thing we can do when it comes to the education piece is to do it in a social marketing framework. When you do social marketing, you have to have a 100 percent aligned and pristine adherence to the messaging. That's one of the tenets of social marketing. But to me that's just one little piece of it. We need to do the research of barriers of why people are using different products and what would help them better understand the implications and to use better products. It's a whole strategy and it can't just be done generally, it needs to be done by product type or category. Let's say it's personal care products or paint or construction materials. So beyond legislation, if we're going to be doing education, we have to do it better and do a lot more than most agencies are willing to put into it.

Beyond social marketing, some agencies are purely trying to align strategies with other agencies within their state. The DEQ representative said, "One of the things [that got] proposed in this updated [Toxics Reduction] strategy is to work with the Oregon Health Authority more on messaging and trying to – rather than be all over the place with the messaging and all these different chemical issues and products – to distill it a little bit more."

An equity focus gap

Interviewees acknowledged the need and importance for focusing on health-vulnerable populations and using an environmental justice approach to their work in context with their role and position in the system of toxics reduction.

Affected communities central to equity work

Several interviewees emphasized the importance of impacted community members being a part of the equity work. One interviewee from an advocacy organization said community groups are essential for toxic reduction efforts to be successful. The interviewees' organization provides funding for community members time in order to participate in meetings because they value their expertise.

For the local government agency interviewees, there seemed to be a greater ability to focus on equity issues more directly than a state agency because of the proximity to local communities. Both the San Francisco Department of Environment and Multnomah County interviewees spoke very emphatically about the importance of community engagement as a part of the programming.

In San Francisco, there are four official languages (Chinese, Spanish, Filipino and English), so translation of program materials to those four are standard. However, if they're targeting a specific

community, such as through their Healthy Nail Salon program,[861] materials had to be targeted for the Vietnamese community. And the materials couldn't just have language translation, they also needed cultural translation, and for that, community partner input was essential. An example given was a used oil disposal campaign where they used Chinese scroll, but the wording was a pun that would be familiar and relevant to the Chinese language community (rather than a direct translation from English). Those culturally relevant campaigns are important for effective communication and behavior change.

The Multnomah County Health Department also sees working with their community as essential, but in their case, they're not necessarily using social marketing, but rather helping communities understand the hazards around them and working with them to fight for their rights. An interviewee used the Bullseye Glass lawsuit as an example where the community was able to understand their rights, come together and sue the company for toxic air pollution in early 2018.[862] Because the Multnomah County Health Department is closer to the communities and local departments, they say they're able to build relationships and understand what "communities are saying." The interviewee says that's a key starting place for working with health-vulnerable populations.

Agency environmental justice initiatives

The Multnomah County Health Department interviewees mentioned that the county is preparing to pass an environmental justice initiative. The goal would be that all departments "from our department that takes care of our bridges, builds our roads, does our mental health services" would consider environmental justice in their work. The interviewees see their role as helping partners understand and take those steps. Additionally, the Multnomah County Office of Sustainability (see more information above) works from an environmental justice lens, and through its discrete role could have some part to play in those initiatives.

Green chemistry

The interviews surfaced several local context examples that we didn't have time to cover with the interviewees. These topics are covered here.

Oregon Green Chemistry Executive Order

Green chemistry, and working with industry on green chemistry, came up in several interviews. The most widely accepted definition comes from the EPA which defines green chemistry as "the design of chemical products and processes that reduce or eliminate the generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use and ultimate disposal."[863] One interviewee provided another description: "we know how to design things that we know are not going to be problematic."

This interviewee described the advantages of a green chemistry approach as the "flip side" of what is currently practiced: "If you know the characteristics of a type of chemical, it shouldn't be that we

[861] "Healthy Nail Salon Program." San Francisco Environment, https://sfenvironment.org/article/healthy-nail-salon-program.
[862] "Bullseye Glass Class-Action Lawsuit." OPB, https://www.opb.org/news/series/portland-oregon-air-pollution-glass/portland-oregon-air-pollution-lawsuit-bullseye-glass/.
[863] Ibid. "Green Chemistry Definition." EPA.

have to test everyone within that family if you already know the basic structure of it is problematic. Which is the same philosophy as green chemistry on the flip side. If you know you have structured your chemical in the way that it is benign, you're fine, you've structured it so that you know it's benign. Why don't we go there rather than worrying about testing all of these other ones where we either suspect or don't know."

There's been movement towards green chemistry regulation in Oregon that began from The Oregon Green Chemistry Advisory Group (OGCAG) convened by The Oregon Environmental Council (OEC) which was published in a report in 2011 .[864,865] Members included DEQ, Business Oregon (Oregon Business Development Department), Oregon Manufacturing Extension Partnership (OMEP), University of Oregon, Portland State University, and business leaders from Nike, Inc., Blount International, Inc., and Coastwide Laboratories. The recommendations of the advisory group led to an Executive Order by Governor Kitzhaber establishing a statewide green chemistry directive.

On April 27, 2012, Governor Kitzhaber signed Executive Order No. 12-05, "Fostering Environmentally-Friendly Purchasing and Product Design,"[866] which has been described (within the media and government offices) as a "green chemistry executive order."[867] DEQ describes actions resulting from the Executive Order (EO) as leveraging state purchasing power to encourage innovation.[868] The EO was created to establish policy around environmental purchasing and product design. It outlined four strategic areas where policies and programs are intended to foster innovation:

Building awareness

DEQ and Business Oregon would conduct strategic outreach in partnership with business leaders to help companies (that provide materials or products that could contain harmful chemicals) about the economic, environmental, and health benefits of using green chemistry. This outreach would help "strengthen competitiveness" and "address chemicals of known and emerging concern." Additionally, the Oregon Department of Administrative Services (DAS) would provide training and information to state agencies on best practices in green purchasing.

Providing innovation tools

DEQ, DAS, and Business Oregon will work with businesses, universities, and other interested organizations to secure funding for green chemistry innovation or proposals for legislation.

Strengthening demand

DAS, in consultation with DEQ, will revise state purchasing and procurement practices to lay out specific guidelines and establish clear preferences for products manufactured through green chemistry principles. By December 31, 2012, implementation guidelines would have taken place

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[864] "Expanding Oregon's Advantage." *Oregon Environmental Council*, 23 Dec. 2014, https://oeconline.org/inspired-innovation-expanding-oregons-advantage-in-sustainable-chemistry-and-materials/.

[865] "Advancing Green Chemistry in Oregon." July 2010, https://oeconline.org/wp-content/uploads/2014/10/Advancing_Green_Chemistry_Report_Sept2010_web.pdf.

[866] "Executive Order No. 12-05: Fostering Environmentally-Friendly Purchasing and Product Design." http://www.oregon.gov/gov/Documents/executive_orders/eo_12-05.pdf.

[867] Ibid. Manning, Rob. "Governor Signs 'Green Chemistry' Executive Order." *Oregon Public Broadcasting*.

[868] Ibid. "DEQ's Toxic Reduction Strategy."

(by DAS through DEQ) and by July 1, 2013 would have completed a plan for revising purchasing guidelines.

Refining toxics reduction strategy

DEQ will "refine and enhance strategies to develop and promote the use of safer alternatives to toxic chemicals," which includes:

- Governor's office will convene a group of agency leaders to work collaboratively on an Interagency Toxic Chemical Reduction Strategy.
- Individual state agencies will integrate green chemistry and safer alternative product policies into their existing programs.
- DEQ will evaluate adequacy of Toxics Use and Hazardous Waste Reduction Program to make modifications and effectively promote green chemistry in businesses and organizations.
- DEQ will identify two industries in Oregon where green chemistry can be applied.

Progress since the Green Chemistry Executive Order was enacted

It's not clear exactly where Oregon is on moving forward with the EO at the moment, but there is some progress evident. One interviewee said there was an idea to identify which sectors had the biggest issues related to toxics use, but, they weren't sure whether that idea got off the ground. This is an area that may be worth following up with Business Oregon and the Oregon Environmental Council as they were leading that charge. Regardless of the specific level of movement in this area, the involvement of business in green chemistry is an example of their leadership versus policy that is regulating their decisions.

A DEQ representative mentioned that there is some movement forward within their agency, but more in the background. DEQ did take details from the EO and created an Integrated Toxics Reduction strategy[869] in 2012 which laid out a series of actions designed to address the following elements:

- Improving Integration and Prioritization of Toxics Reduction Activities
- Enhancing Effective Existing Toxics Reduction Activities
- Addressing Identified Toxics Reduction Needs
- Assessing and Characterizing Toxics in Oregon

The strategy is currently in the process of being updated, which the interviewee from DEQ spoke about around the work they are doing at this moment (see *Collaboration* section for more details).

Examples of green chemistry policies and practices

An interviewee from the Washington Department of Ecology referenced Washington's Children's Safe Products Act[870] as an example (with similar laws in California and Oregon) that have impacted

[869] Ibid. "DEQ Integrated Toxics Reduction Strategy."
[870] "WA Children's Safe Products Act." https://fortress.wa.gov/ecy/publications/documents/0907014.pdf.

the supply chain and ensure that manufacturers know what's in their products. This regulation in Washington does have some limitations. Once manufacturers find out and then disclose to the state what's in their products, it's up to them what they do with that information. Washington Department of Ecology is in charge of pulling products off shelves and testing them for compliance, "like a cop on the beat." The department received funding to dedicate a position to product testing. The Ecology interviewee notes that the testing seems to be working really well, but it does require substantial resources.

The example in California that the Ecology interviewee referenced was the California Safer Consumer Products (SCP) Program,[871] a green chemistry initiative with a goal to reduce the toxic chemical exposure from everyday product use and to participate in promoting the development and technology around greener products. They have a pretty detailed process of identifying and regulating hazardous products.[872]

Washington Department of Ecology is also working on identifying solutions to the industry working around chemical bans. The interviewee noted that sometimes if a chemical is banned, a manufacturer will tweak the chemical formulation to come up with a slightly different chemical structure that has the same negative impacts. The solution to this problem of "regrettable substitutions" is something they call "informed substitution" through "alternative assessments" to identifying safer alternatives.

The representative from the Oregon advocacy organization says focusing on green chemistry "is really how we're going to make widespread change in toxics in products" and through procurement policies in particular. They said, "that is the way you can really get at a bunch of different products at once." For example, cleaning supplies, plastics and others can be impacted through green chemistry procurement policies.

There are some examples of marketing moving towards more transparency. Several interviewees brought up Walmart, Patagonia and Nike (among others) that are trying to source environmentally friendly materials and promote their effort.

[871] Ibid. "Safer Consumer Products Program." California Department of Toxic Substances Control.
[872] Ibid. Singla, Veena. "New California program is on a Mission to Reduce Toxic Chemicals in our Everyday Products."

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