HANDBOOK ON REDUCING CHEMICAL FOOTPRINTS

Chapter 2. Chemical Footprints

The collective human chemical footprint is very large; we use a lot of chemicals and leave our tracks all over. This chapter takes a broad look at the numbers of chemicals in commercial use today and current efforts to limit use of those chemicals that raise human health and environmental concerns. Chemicals have many useful applications, but we do not always know what hazards might be associated with their application. History has identified several important cases of chemicals, once common, that were later found to cause significant damage; a few of these case studies are briefly discussed. Though policies have been adopted to address these concerns, there is little regulatory control over most chemicals in use today, and little public information on chemical ingredients. Current regulation of chemicals in personal care, household and home gardening products are briefly described before turning to the chemical footprint concept. The goal of a chemical footprint analysis, as introduced in this chapter, is to inspire individuals to take account of their full chemical footprint and to encourage action to reduce the size of that footprint, especially the use of chemicals of concern.

More than 84,000 chemical substances are registered with the US Environmental Protection Agency for commercial use.

Introducing the World of Chemicals

Enterprising individuals and corporations are driven to identify and develop chemicals to save lives, increase comfort and convenience, cut costs while extending shelf-life, improve productivity and efficiency, and address countless other consumer and manufacturer interests. We have gained significant benefit from the wide array of chemicals in consumer products. Today we find chemicals of all kinds in almost every aspect of our lives.[1]

Tens of thousands of synthetic chemicals are in commercial use. This includes the more than 84,000 chemical substances manufactured or processed in the US that are registered with the US Environmental Protection Agency (EPA) under the

[1] Globally, more than 91 million unique organic and inorganic chemical substances, both naturally occurring and synthetically derived, have been identified, developed and registered with the Chemical Abstracts Service (CAS), a division of the American Chemical Society. According to CAS, approximately 15,000 new substances are added each day. For more information on this global chemical registry system, see "CAS REGISTRY - The gold standard for chemical substance information," available at http://www.cas.org/content/chemical-substances.

requirements of the Toxic Substances Control Act (TSCA).[2] Many other potentially hazardous chemicals are covered under separate laws, including substances in food, food additives, drugs, cosmetics, pesticides, tobacco products, firearms and nuclear materials.[3]

Rising Concerns Related to Chemical Exposures: Lessons from History

Modern societies are engaged in a difficult balancing act: how to gain the benefits from new chemicals without introducing harm. History provides us with several examples of failures in the balancing act, where chemical products were enthusiastically embraced only to be followed later with experience and information of harmful effects. The chemical compound DDT (dichloro-diphenyl-trichloroethane) was developed in the 1940s as the first synthetic insecticide to combat malaria, typhus and other insect-borne diseases. It was also widely used for insect control in agriculture, institutional, home and home gardening applications. In 1948, the Nobel Prize in Physiology or Medicine was awarded to Swiss chemist Paul Müller, "for his discovery of the high efficiency of DDT as a contact poison against several arthropods."[4] The Nobel Committee, like many at the time, believed that DDT would preserve the lives and health of hundreds of thousands. This led to broad applications of DDT, such as in the evacuation of World War II concentration camps and in prisons. Only later did Rachel Carson identify the link between the widespread use of DDT and other synthetic pesticides and environmental damage, including a decline in bird populations where DDT was being applied.[5] The bald eagle population declined due to the DDT drastically thinning their eggshells.[6]

Hexachlorophene was another chemical synthesized in the 1940s, added to soap and hospital cleaning solutions as an antibacterial compound. Dial® soap was the first consumer product containing hexachlorophene (called "AT-7" by the manufacturers of Dial®). Advertisements for

[2] US Environmental Protection Agency, "TSCA Chemical Substance Inventory: Basic Information," last updated on 3/13/2014, available at http://www.epa.gov/oppt/existingchemicals/pubs/tscainventory/basic.html#background.

[3] TSCA, enacted in 1976, was designed to regulate the chemical industry. Chemical substances regulated under other laws – such as the Federal Food, Drug and Cosmetic Act, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), or the Atomic Energy Act – are not covered under the TSCA notification and tracking system. See the EPA "Summary of the Toxic Substances Control Act" at http://www2.epa.gov/laws-regulations/summary-toxic-substances-control-act.

[4] Nobelprize.org, "The Nobel Prize in Physiology or Medicine 1948," accessed 2015 (http://www.nobelprize.org/nobel_prizes/medicine/laureates/1948/).

[5] Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962).

[6] Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962).

this soap "emphasized the effectiveness of the product in killing a particular kind of bacteria – the kind that made human perspiration stink."[7] Effective advertising was credited for creating "the sweet smell of success," as described by chemical product industry representatives at the time, and built interest in developing and marketing similar kinds of products.[8] Hexachlorophene was subsequently added to other products, including pHisoHex® which was once available as an over-the-counter antibacterial skin cleanser advertised as effective for acne control. The substance was found to be highly effective, particularly in hospital settings. The chemical was banned from consumer products in 1972 after several deaths resulted when hexachlorophene was applied to individuals with burned or otherwise damaged skin. Other observed effects included nerve damage, renal disturbance and skin irritation in humans, as well as toxic and reproductive results in laboratory animal tests.[9] Dial® soap changed its formula; today it contains the antibacterial substance triclosan (currently a contaminant of concern). Hexachlorophene remained available as a prescription treatment option for many years but is no longer being produced.[10]

1950 ad promising that Dial "removes the skin bacteria that are the major *cause* of perspiration odor... doesn't just 'cover up.' Perfect for complexions, too. Get *several* bars of Dial today."
Source:
https://clickamericana.com/topics/beauty-fashion/vintage-dial-soap

Bad outcomes with chemical substances found in common personal care products have forced the US Food and Drug Administration (FDA) to take restrictive action on several others. Bithionol (banned by the FDA from personal care products in 1968) and halogenated salicylanilides (banned in 1975) were both used as antimicrobial agents in cosmetics later found to cause disabling skin disorders, especially abnormal sunburn response to sun exposure.[11] Vinyl chloride, once common in

[7] Martha Gardner, "'Development of a Germicidal Soap': The Invention and Use of Hexachlorophene in the American Post–World War II Age of Confidence and Cleanliness," a talk before the Chemical Heritage Foundation, Brown Bag Lectures, March 8, 2011 (http://www.chemheritage.org/visit/events/public-events/2011-03-08-bbl-gardner.aspx).

[8] Ibid.

[9] R.D. Kimbrough, "Review of the Toxicity of Hexachlorophene, Including Its Neurotoxicity," *The Journal of Clinical Pharmacology and New Drugs* 13, 11 (November-December 1973): 439-444; article first published online March 11, 2013 (http://onlinelibrary.wiley.com/doi/10.1002/j.1552-4604.1973.tb00196.x/abstract).

[10] American Society of Health-System Pharmacists (ASHP), "Drugs No Longer Available: Hexachlorophene 3% Detergent Cleanser (PHisoHex)," October 2, 2013 (http://www.ashp.org/menu/DrugShortages/DrugsNoLongerAvailable/Bulletin.aspx?id=1059).

[11] For bithionol, see Legal Information Institute, "21 CFR 700.11 - Cosmetics containing bithionol," Cornell University Law School, accessed 2015 (https://www.law.cornell.edu/cfr/text/21/700.11). For halogenated

***Our Stolen Future*, published in 1996, documented the groundbreaking work of Theo Colborn and inspired expanded research on the effects of chemical exposures on developing human and wildlife endocrine systems.**
Source: http://en.wikipedia.org/wiki/Our_Stolen_Future

hairsprays, was banned from cosmetic aerosol products in 1974 in response to mounting evidence of acute toxicity from inhalation and carcinogenic effects, including liver cancer.[12] Zirconium-containing compounds were banned in 1977 from aerosol antiperspirants when they were found to cause toxic effects in the lungs as well as skin damage.[13] In all of these cases, restrictions were applied after damage had already occurred.

The endocrine-disrupting effects of certain synthetic chemicals were a new focus of research in the 1990s. Particularly influential was the work of Theo Colborn, who found that exposure in even very small amounts to a variety of synthetic chemicals resulted in hormonal, reproductive, and fetal developmental changes in humans and other species.[14] Among other substances, polychlorinated biphenyls (PCBs, once used very widely in electrical, insulating, flexible adhesive and a multitude of other applications) and bisphenol A (BPA, very common in plastics) were found to be endocrine-active compounds. These mimic the effects of hormones and cause other physiologic changes, such as changes to the reproductive system.[15]

These findings spawned a new research agenda focused on the complex ways that altered endocrine function is expressed in cells, individuals and populations. Perhaps most significantly, many see the new emphasis on endocrine disruption as marking a fundamental change in toxicological analysis, from research that starts with adverse toxicological outcomes ("what caused these results?") to a reverse approach. The reverse approach is one which anticipates possible negative consequences from chemical exposures based on knowledge of biological

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salicylanides, see Legal Information Institute, "21 CFR 700.15 - Use of certain halogenated salicylanilides as ingredients in cosmetic products," Cornell University Law School, accessed 2015 (https://www.law.cornell.edu/cfr/text/21/700.15); L.C. Harber, S.E. Targovnik and R.L. Baer, "Contact Photosensitivity Patterns to Halogenated Salicylanilides," *Archives of Dermatology* 96, 6 (December 1967): 646-656 (http://archderm.jamanetwork.com/article.aspx?articleid=530465).

12 Legal Information Institute, "21 CFR 700.14 - Use of vinyl chloride as an ingredient, including propellant of cosmetic aerosol products," Cornell University Law School, accessed 2015 (https://www.law.cornell.edu/cfr/text/21/700.14).

13 Legal Information Institute, "21 CFR 700.16 - Use of aerosol cosmetic products containing zirconium," Cornell University Law School, accessed 2015 (https://www.law.cornell.edu/cfr/text/21/700.16).

14 Theo Colborn, Dianne Dumanoski and John Peterson Myers, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival? A Scientific Detective Story* (New York: Dutton, 1996).

15 Minnesota Pollution Control Agency, "Endocrine-active compounds," updated June 3, 2015, available at http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/water-quality-and-pollutants/endocrine-disrupting-compounds.html.

mechanisms ("what should we expect from cumulative exposures to these substances?").[16] As Colborn et al. put it in *Our Stolen Future*, researchers were now engaged in "a scientific detective story." Essentially, endocrine disruption research launched the precautionary approach to chemical analysis and interest in looking for the potential of harm before it occurs.

Government Oversight of Chemicals

Historic experience with chemicals, such as the ones just described, has led to the adoption of many laws in the US to control chemicals. Despite this, most chemical substances remain untested today for human health and environmental risks[17] and are largely unregulated. TSCA provides the EPA with authority to set rules for the manufacture, processing, distribution, use, or disposal of chemical substances.[18] With tens of thousands of chemicals in common use, and with many questions as to potential risks, there are many candidates for regulation. However, since TSCA was enacted in 1976, the EPA has issued regulations to ban or limit the production of only five existing chemicals: asbestos, chlorofluorocarbons (CFCs), lead, PCBs and radon. Under this same law, only about 200 chemical substances have been required by the EPA to undergo thorough testing for toxic human health and environmental impacts since 1976.[19]

Chemical Restrictions by the numbers:

- **EPA has required thorough testing of approximately 200 of the 84,000 chemicals in commercial use.**
- **5 chemicals are banned or subject to an EPA-enforced general production limit.**
- **11 ingredients have been specifically prohibited or restricted by the FDA for use in personal care products.**

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16 Mary Sue Marty, Edward W. Carney and Justin Craig Rowlands, "Endocrine Disruption: Historical Perspectives and Its Impact on the Future of Toxicology Testing," *Toxicological Sciences* 120, 1 (2011): S93-S108 (http://toxsci.oxfordjournals.org/content/120/suppl_1/S93.full).

17 The serious lack of information on chemicals in use came very clear in the aftermath of the January 2014 spill from a holding tank into West Virginia's Elk River, the main source of drinking water for the state's capital, Charleston. As Elizabeth Shogren of National Public Radio's *All Things Considered* reported on January 13, 2014, the US Centers for Disease Control (CDC) had no established safety standard for the chemical that had spilled, 4-methylcyclohexane methanol (MCHM), and the only source of information came from a single laboratory rat study. In particular, there was no available data on either acute or chronic health effects such as carcinogenic, mutagenic or developmental toxicity. Meanwhile, the citizens of West Virginia were left wondering what risks to their health and the environment might be present in their contaminated water supply. (See the National Public Radio story, "The Big Impact of a Little-Known Chemical in W.Va. Spill," at http://www.npr.org/2014/01/13/262185930/mysteries-persist-surrounding-west-virginia-chemical-spill).

18 Toxic Substances Control Act (as amended through Public Law 107–377, December 31, 2002), Sec. 6, "Regulation of Hazardous Chemical Substances and Mixtures," available from the U.S. Senate Committee on Environment and Public Works at http://www.epw.senate.gov/tsca.pdf.

19 Natural Resources Defense Council, "Now is the Time to Reform the Toxic Substances Control Act," April 2010, available at http://www.nrdc.org/legislation/files/tscareformmar2010.pdf; US Government Accountability Office, "Chemical Regulation: Actions are Needed to Improve the Effectiveness of EPA's Chemical Review Program" (GAO-06-1032T), August 2, 2006 (http://www.gao.gov/products/GAO-06-1032T).

Oversight of Chemical Ingredients in Cosmetics and Personal Care Products

Personal care products are regulated by the FDA. Cosmetic products and ingredients (which include items ranging from shampoos, skin moisturizers and deodorants to makeup and perfumes) do not need FDA approval before they go on the market. Only eleven ingredients have been specifically prohibited or restricted by the FDA for use in personal care products: several antimicrobial substances (bithionol, halogenated salicylanilides, hexachlorophene); several aerosols (chlorofluorocarbon propellants, methylene chloride, vinyl chloride, zirconium-containing complexes); chloroform; mercury compounds; prohibited cattle materials (linked to "mad cow disease"); and sunscreens in cosmetics (regulated as a drug, not a cosmetic).[20] Some of these are still available in prescription remedies. Beyond this, manufacturers must follow certain labeling requirements and are otherwise expected to abide by the more general dictate against the use of "any ingredient that makes a cosmetic harmful when used as intended."[21] Some companies use a questionable tactic of "trade secrets" to conceal harmful chemicals in their cosmetic and personal care products from the public.

Oversight of Chemical Ingredients in Household Products

Manufacturers of chemicals for household use must comply with chemical registration and use limits established by the EPA and FDA. Additional responsibility for regulating most household products falls in the hands of the US Consumer Product Safety Commission (CPSC), which is charged with "protecting the public from unreasonable risks of injuries and deaths associated with the use of consumer products," including chemical hazards.[22] Most CPSC rules applied to chemicals focus on labeling and packaging requirements, as well as product safety tests that manufacturers of some products are expected to perform to evaluate hazards. Many labeling exceptions have been adopted, such that most chemical ingredients do not need to be listed on packaging materials, though warning statements are often required, such as "Caution," "Harmful if Swallowed" or "Keep out of the reach of children."[23] Industry leaders are generally

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20 US Food and Drug Administration, "Cosmetics: Prohibited & Restricted Ingredients," updated January 26, 2015 (http://www.fda.gov/Cosmetics/GuidanceRegulation/LawsRegulations/ucm127406.htm); specific rules on these ingredients can be found in the *US Code of Federal Regulations,* title 21, Part 700, Subpart B (Sections 700.11 through 700.35) – "Requirements for Specific Cosmetic Products," US Government Printing Office (http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=c108128827d21f2d274e894731665ef4&rgn=div6&view=text&node=21:7.0.1.2.10.2&idno=21).

21 Ibid.

22 US Consumer Product Safety Commission, accessed 2015 (http://www.cpsc.gov/en/).

23 For examples of consumer product labeling exceptions, see *US Code of Federal Regulations,* Title 16, Chapter II, Subchapter C, Part 1500, §1500.83, "Exemptions for small packages, minor hazards, and special circumstances" (available at http://www.ecfr.gov/cgi-bin/text-idx?SID=3e7636d98dae34c20e70cc20b4522f76&node=16:2.0.1.3.79.0.1.30&rgn=div8). For an overview of information required by law to be stated on a package of a product that is hazardous, see "Federal Hazardous

interested in keeping their ingredients and product recipes confidential and have managed to gain approval for vague product ingredient lists.[24]

Oversight of Chemical Pesticides Used at Home

The EPA has responsibility for overseeing chemicals in antimicrobial pesticides and home gardening pesticides. Antimicrobial pesticides are chemicals used to protect products (rather than people) from bacteria, viruses, fungi and other microbiological organisms. They are incorporated into production or applied as a finish to items such as textiles, fibers and plastics.[25] The EPA also requires registration of pesticides used for control of insects, weeds, and other pests in the home and garden. The registration process includes consideration of product ingredients, how and where the product is to be used (such as indoor versus outdoor use), anticipated frequency of application, and storage and disposal practices. EPA determinations from this review are reflected in pesticide use restrictions, including limiting use to those with special training. EPA also sets labeling requirements, with many states applying additional pesticide use and labeling rules.[26]

Chemicals are subject to many rules, but few are subject to strict control. Information on toxicity and impacts related to chemical exposures remains limited. Lack of broad public interest and issue complexity dampen demand for greater review of this issue. Product marketing and industry desire to keep regulatory interference at a minimum also contribute to the limited amount of testing and regulation. Many assume that the government will step in to ban harmful chemicals, which is often not the case.

For those who are interested, existing information is often highly guarded. Nearly 20 percent of the chemicals registered with the EPA under TSCA – approximately 17,000 chemicals in commercial use – are kept secret from both citizens and most public officials as to their names and physical properties.[27] As *Washington Post* reporter Lyndsey Layton detailed in 2010, at least some of the secret chemicals have been associated with "substantial risk" reports filed with the EPA, "151 are made in quantities of more than 1 million tons a year and 10 are used specifically in children's products, according to the EPA."[28] The few individuals who know these chemical

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Substances Act (FHSA) Requirements," December 04, 2012 (http://www.cpsc.gov/en/Business--Manufacturing/Business-Education/Business-Guidance/FHSA-Requirements/).

24 For discussion of the limits to labeling of consumer product ingredients, see Environmental Working Group, "EWG's Guide to Healthy Cleaning: Frequently Asked Questions," accessed 2015 (http://www.ewg.org/guides/cleaners/content/faq). See in particular items 39 and 40.

25 US Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances, "Reregistration Eligibility Decision for Triclosan" (EPA 739-RO-8009), September 2008, now archived. For the list of triclosan uses, see "Triclosan Appendix A: Use Patterns Eligible for Reregistration," beginning on p. 49 (http://www.epa.gov/oppsrrd1/reregistration/REDs/2340red.pdf).

26 US Environmental Protection Agency, "Pesticide Registration," updated February 11, 2015 (http://www2.epa.gov/pesticide-registration).

27 Lyndsey Layton, "Use of Potentially Harmful Chemicals Kept Secret Under Law," *Washington Post,* January 4, 2010 (http://www.washingtonpost.com/wp-dyn/content/article/2010/01/03/AR2010010302110.html).

28 Ibid.

identities are legally barred from sharing that information with public officials, emergency responders, and members of the public.[29]

Policies are in place assigning government regulatory responsibility for chemicals in commercial use. However, the bottom line for most consumer products is clear: government agencies have little authority to require testing of product or ingredient safety. Lack of information makes it hard to prioritize chemicals of concern and establish production and usage limits. Some broadly used chemicals have been independently studied and found to have significant public health and environmental effects, even when exposures are at very low concentrations. Current policy has no real power to respond to such information. For now, it appears that individuals and communities will need to adopt some of their own prevention measures.

The Chemical Footprint Concept

A chemical footprint accounts for all of the chemicals used by individuals and groups in society. Some of these chemicals cause known or suspected harm to humans and other species. A larger footprint with more of these harmful substances increases the risk of negative effects on individuals and group members.

Many chemicals of concern expose both humans and the environment via the water system.

A larger chemical footprint also increases the chemical risk to the broader human community and the vast array of species existing in ecosystems at large. Though wastewater treatment removes many contaminants, unregulated chemicals are not regularly monitored or eliminated in established water treatment systems. Thus, trace amounts of chemicals of concern – often complex "cocktails" of chemicals – regularly enter the water system, moving and accumulating in downstream water sources. We all rely on these water sources. Public drinking water is drawn from these sources, and wildlife also depends on these same water sources.

Chemical Footprint

The total of ALL CHEMICALS used by an individual, found in personal care products, pharmaceuticals, common household items, cleaning supplies, and home gardening products.

The chemical footprint concept is similar to other footprint analyses. Ecological footprint assessments measure human demands on nature against the Earth's capacity to produce resources and absorb waste – promoting lower levels of resource consumption to better achieve ecological sustainability.[30] Carbon

[29] Ibid.

[30] The ecological footprint concept was first developed in the early 1990s by William Rees and Mathis Wackernagel at the University of British Columbia. They subsequently published a book entitled *Our Ecological Footprint: Reducing Human Impact on the Earth* (New Society Press, 1996). The Global Footprint Network, an organization led by Wackernagel, makes an ecological footprint calculator available for free online (see http://footprintnetwork.org/en/index.php/GFN/page/calculators/).

footprint studies calculate climate-changing gas emissions related to various human activities, including transportation, diet and energy use. The focus is to promote awareness of how individual choices affect broader environmental conditions and to encourage individuals to find ways to reduce their carbon emissions.[31]

The ambition of individual chemical footprint evaluation is to encourage full accounting of the chemicals of concern that comprise the personal and collective consumption footprint and to find ways to reduce the size of that footprint.[32] Accurate measurement of chemical use at the individual level is not yet possible. However, the chemical footprint concept provides an important conceptual metric for chemical consumption. It is more than a definition. The chemical footprint concept launches a process for assessment and action.

Chemical Footprint Evaluation and Response

The process of chemical footprint evaluation and response starts with **accounting for all of the chemicals**, both known and hidden, in individual product use. Product labels specify some of these chemicals, but not all products require a detailed list of ingredients. "Fragrance," "flavor," and "surfactants" all appear on product labels, along with many other trade secret formulas accepted by the government as exempt from listing under nondisclosure agreements. Because consumers are left with incomplete information on chemical content in the products they use, the accounting does not result in an actual calculation. Instead, this first step in the chemical footprint evaluation encourages greater awareness of our broad reliance on chemicals and the potential for exposure to substances that might cause harm.

Step two in individual chemical footprint evaluation focuses on **identifying specific chemicals of concern** in the products in use. Many chemicals have proven to be both useful and safe. Only some chemicals are hazardous to human health and the environment. Which are present in the products we use? For individuals ready to evaluate their chemical footprints, reading product labels and gathering additional information on chemical content are valuable activities. The next chapter describes several chemicals needing further attention due to their toxic potential and

31 Several carbon footprint calculators are available online, including: the "CoolClimate Carbon Footprint Calculator" provided by CoolClimate Network, a university, government and NGO partnership at the University of California, Berkeley (see http://coolclimate.berkeley.edu/carboncalculator); The Nature Conservancy's "What's My Carbon Footprint?" calculator (see http://www.nature.org/greenliving/carboncalculator/); and the US EPA's "Household Carbon Footprint Calculator" (see http://www.epa.gov/climatechange/ghgemissions/ind-calculator.html).

32 Chemical footprint analysis has proven to be especially complex. While there is growing consensus on the conceptual components of the chemical footprint, designing an actual calculator continues to challenge researchers. A Chemical Footprint Project tool administered by Clean Production Action is now available to encourage "corporate progress to safer chemicals in products, manufacturing, and supply chains." The tool uses four measures of corporate chemical management performance: management strategy; chemical inventory; progress measurement; and public disclosure. (See the Chemical Footprint Project, http://www.chemicalfootprint.org/.) An ongoing European Commission Joint Research Centre effort identifies three important elements in sustainable chemical management: life cycle assessment, risk assessment for human and ecological exposure, and the precautionary principle that addresses uncertainties associated with the impacts of chemical pollution. See the summary and link to the original article in "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol (23 January 2014, Issue 358), available at http://ec.europa.eu/environment/integration/research/newsalert/pdf/358na6_en.pdf.

persistence in the environment, and the types of products that contain these substances. This handbook documents:

- Why these chemicals raise concern, including known and suspected effects on humans and other species
- How the chemicals, once applied, do not just "disappear" but instead are transported, typically through the water system, to the environment at large
- Why we cannot rely on current water treatment methods to remove these contaminants; and
- What are the limits of our regulatory system for establishing rules to prevent harm from occurring.

Step three involves **committing to an individual chemical reduction plan**. Changes do not occur just because we have information. Commitment is a decision process that matches ideas with a do-able plan. There are many chemicals of concern. Without a plan, the issues could be overwhelming. What should we focus on? This is a question for the individual to answer. It depends on what products one is using and the availability of alternatives for addressing one's needs. Select one or more chemicals of concern or products containing such chemicals that you will reduce in your own product use. Write it down. Tell others about it. Create reminders so you do not forget.

The final step concentrates on **taking action**. Incorporate alternatives that involve fewer chemicals, and especially chemicals of concern, into daily life. Chapter 9 lists a number of such alternatives. Pick and choose ones that make sense for you, and that allow you to measure your own steps to reduce your chemical footprint. There are multiple options for achieving reductions, including using less of the substances that cause harm, replacing what is needed or desired with non-toxic alternatives, or deciding to avoid a particular type of product altogether.

Individual Chemical Footprint Evaluation and Response

1. **Account** *for all chemicals in consumer products being used.*
2. **Identify** *specific chemicals of concern in products being used that pose human health and environmental harms.*
3. **Commit** *to reducing your chemical footprint by making a decision and a plan.*
4. **Take action** *by cutting or replacing use of one or more chemicals of concern or products containing such chemicals.*

The point of chemical evaluation and response is two-fold: to recognize the connection between use of products containing hazardous chemicals and potential negative health and ecological impacts, and then to make an effort to identify and reduce exposure to those substances. The chapters that follow will help individuals learn more about their own chemical footprints. The government does not have all the information. Lack of complete information on chemicals in use, how they are applied, and the potential for negative consequences makes it very difficult to create a full accounting of one's chemical footprint. Waiting for governments to decide on and develop new policies is unlikely to solve the problem. Instead, we can take steps now to understand – and reduce – our own chemical use.

Summary

Chemicals are everywhere. As history has shown, many cause harm. Many common products contain chemicals of concern that are linked to known or suspected harmful effects on human health and the environment. Policies have been adopted to address concerns related to chemical use and exposures, but many of these policies protect the interests of manufacturers over the interests of consumers and the environment. Chemicals suspected to be harmful remain on the market while some product ingredients are hidden behind trade secret rules. In spite of these limits to regulatory rule, many people share an interest in reducing personal and environmental exposures to potentially hazardous substances. Our individual chemical footprints include all of the chemicals we use, including personal care products, household cleaners, plastic containers and gardening products. Identifying chemicals of concern in common products gives individuals the power to reduce their own chemical footprints. A smaller chemical footprint reduces individual exposure risk and, equally important, reduces the amount of harmful chemicals entering the water system and the environment at large.