"Many of the problems facing the world today can be traced back to how we make, consume, and toss our mountains of stuff. Annie Leonard takes us on a much-needed journey into the heart of stuff, and brings us back again with the knowledge and optimism to change our lives and our society."

—Tim Kasser, Ph.D., professor & chair of psychology, Knox College, and author of *The High Price of Materialism*

"Annie Leonard's marvelous new book could not have appeared at a better time, as people across the country (and the world), and young people in particular, grapple with the interconnected issues of consumption and our environmental, social, and economic crises. I recommend *The Story of Stuff* to students everywhere: it's a must-read for anyone looking to make a profound difference."

—Michael Maniates, professor of political science and environmental science at Allegheny College, co-editor of *Confronting Consumption* and *The Environmental Politics of Sacrifice*

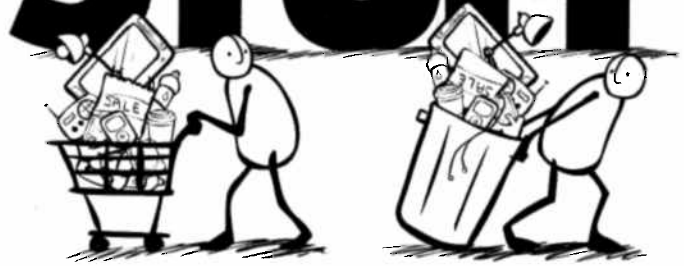
"Annie Leonard's is the rare voice who can pose fundamental questions about our economic system without alienating or frightening her audience. With *The Story of Stuff*, she provides not only a comprehensive look at what's broken, but a bridge to a whole new economic, social, and environmental reality."

—James Gustave Speth, author of *The Bridge at the Edge of the World: Capitalism, the Environment, and Crossing from Crisis to Sustainability*

"*The Story of Stuff* is a brilliantly argued triumph of common sense and optimism. A work of great courage, it offers the greatest possible public service: speaking truth to power. A compelling and vitally important book for our troubled times."

—Ellen Ruppel Shell, author of *Cheap: The High Cost of Discount Culture*, professor and co-director of the Graduate Program in Science Journalism, Boston University

THE STORY OF STUFF



HOW OUR OBSESSION WITH STUFF IS TRASHING THE PLANET, OUR COMMUNITIES, AND OUR HEALTH —AND A VISION FOR CHANGE

Annie Leonard
with Ariane Conrad

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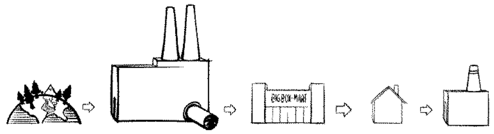
CHAPTER 2 

PRODUCTION

If you were surprised by how complicated it turns out to be to assemble a list of natural ingredients from the forests and rivers and mountains, and how extractive industries have impacts that you never considered (civil wars!), just wait. The next stage—production—might make your head spin. "Production" is the term for taking all the separate ingredients, mixing them together in processes that use lots of energy, and turning them into our Stuff.

In the previous chapter I described how we get most of the materials and all the energy needed for production. However, there's one last category of ingredient that isn't found on top of the earth, or even underneath its surface: synthetic materials. Chemists combine molecules to create polymers, which make things harder, stretchier, softer, stickier, glossier, more absorbent, longer lasting, or flame or pest or water resistant. They also make alloys, or combinations of metals mixed together to give them specific properties—for example, stainless steel combines the strength of iron with the anticorroding qualities of chromium. Other common synthetic materials include plastics, polyester, and ceramics.

Today, there are about one hundred thousand synthetic compounds in use in modern industrial production.[1] They are so ubiquitous that most of the Stuff we're used to having in our lives can't be made without synthetic ingredients, or it can't be made with quite the same qualities (not quite as shiny or stretchy or what have you). Now, synthetics aren't inherently good or bad. Some are even made from natural ingredients while others are wholly developed in a laboratory. The distinction is simply that the new compound is something that didn't exist naturally on earth.

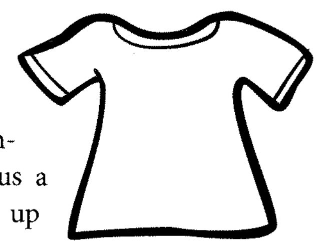
The trouble with synthetics is that most of them are a big unknown in terms of their impacts on our health and the health of the planet. Because few of them have been tested in the half century or so that most of them

have been around,[2] we run a risk by using them and exposing ourselves to them. The old thinking about chemical ingredients was that low enough exposure prevented health risks. But as was proved in the groundbreaking research of Dr. Theo Colborn and Dr. John Peterson Myers, environmental scientists and coauthors (with Dianne Dumanoski) of the 1996 book *Our Stolen Future*, low-dose exposures over time can have tragic outcomes, with the worst fallout from even infinitesimal levels of chemical contamination showing up in the next generation(s) as reduced intelligence, lowered immunity, ADD, infertility, cancer, and other potential effects of which we're not even yet aware.[3] In the upcoming section on dangerous materials I'll talk about the negative impacts of some of the synthetics that we've already been able to track.

But first, now that we've got the gamut of necessary ingredients—stacks of logs, tankers of water, mounds of metals, barrels of petroleum, piles of coal, yards of synthetic fibers, vats of chemical compounds, etc.—it's time to peer into some factories and witness our Stuff being made.

Of course, the process of production looks different for different kinds of Stuff. But there are also similarities—for example, every single production process requires an input of energy, and right now this is nearly always provided by burning coal or oil. I decided to approach the overwhelming number of production processes that are out there by investigating just a few of my favorite things, along with a few of my least favorite.

My Cotton T-Shirt



What a great invention, right? It's comfy, breathable, washable, absorbent, and versatile. I can wear it under a blazer to an important meeting, over a swimsuit at the beach, or with my jeans—plus or minus a sweater—in just about every season. I can pick one up almost anywhere, even the grocery store or drugstore, and I'll only have to spend $6.99 or $4.99 or maybe even $1.99 if I get a multipack or catch a sale. What's not to love? Well, let's see . . .

I intentionally leave out agricultural products and food in telling the Story of Stuff; there are plenty of other people, books, and films covering those issues. But to unravel the story of my T-shirt, which provides a window into the whole textiles industry, we have to start out in the fields. Fluffy, thirsty, toxic: that could be the tagline for cotton, a shrub native to the tropics but today grown in the United States, Uzbekistan, Australia, China, India, and small African countries like Benin and Burkina Faso, with total global production at more than 25 million tons per year, or enough to make fifteen T-shirts for every person on earth.[4]

Cotton plants love water—in fact it's one of the world's most heavily irrigated crops.[5] And irrigation—with the exception of drip irrigation, currently used in a mere 0.7 percent of world irrigation systems—wastes a lot of water through seepage and evaporation.[6]

One of the big issues with cotton and water brings us back to the concepts of virtual water and the water footprint introduced in the last chapter; cotton-buying countries are using up tons of water outside their borders. For example, about half of the 176 cubic yards (135 cubic meters) of water used per year for cotton consumption per person in the United States come from outside the United States.[7] In Europe, a full 84 percent of the cotton-related water footprint comes from elsewhere in the world,[8] which means U.S. and European consumers are essentially soaking up the water of cotton-producing countries elsewhere, decreasing the water available to people in those places, and leaving them to figure out how to handle the resulting water scarcity problems. (Note that the water footprints refer to water use not just in growing but also processing cotton, as well as the water pollution caused by both.) With global water scarcity increasing and impacting public health in a huge way, this scenario is downright unfair and is reason enough to pause before adding yet another cotton t-shirt to our already full drawers.

One of the most tragic examples of water depletion is the former Soviet state of Uzbekistan, where state-run cotton farms drained the rivers that flowed into the Aral Sea, the world's fourth-largest inland sea, reducing its volume of water by 80 percent between 1960 and 2000 and creating a near desert out of the once green and fertile area.[9] The shrinking of the Aral Sea has literally changed the climate of the area, causing shorter, hotter summers and colder winters, less rainfall, and tremendous dust storms. The dust carries salt and pesticides including DDT, which are resulting in a host of public health crises. Growing cotton is not just depleting the *quantity* of water, it's also damaging the *quality* of water that remains; there's less water overall and what remains is increasingly polluted by agricultural chemicals.[10] And we're talking about a ton of chemicals.

Though it takes up just 2.5 percent of the world's croplands, cotton uses 10 percent of the world's fertilizers and 25 percent of its insecticides[11]; agribusiness spends nearly $2.6 billion worth of pesticides on cotton plants every year.[12] Farmers in the United States apply nearly one-third of a pound of chemical fertilizers and pesticides for every pound of cotton harvested.[13] Many of the pesticides (which include insecticides, herbicides, and fungi-

cides like aldicarb, phorate, methamidophos, and endosulfan) are among the most hazardous chemicals and carcinogens in existence and were originally developed by scientists for simultaneous use as nerve agents in warfare alongside their use as insecticides.[14]

In conventional cotton farming, chemicals are first sprayed on the fields before planting to fumigate the soil. The cotton seeds themselves are often dipped in fungicide. Then the plants are sprayed with pesticides several times over the course of the growing season.[15]

These chemicals are indiscriminate: they kill beneficial insects and microorganisms in the soil in addition to bugs that eat the cotton plants. Snuffing out the good bugs means eliminating the natural predators of bad bugs, which creates the need for yet more pesticides. Meanwhile more than 500 species of insects, 180 weeds, and 150 fungi have developed resistance to pesticides.[16] All of this keeps chemical companies busy developing more, while farmers get stuck on "pesticide treadmills." Further compounding the problem, industrial agriculture has whittled hundreds of diverse species of cotton down to just a handful of varieties; the common practice known as monocropping (planting farms with just one variety) makes farms even more vulnerable to pests, which love to feed on big fields of one consistent meal.

Even when used according to instructions, pesticides drift into neighboring communities, contaminate groundwater and surface water as well as animals like fish, birds, and humans—and, above all, the farmworkers. Cotton workers frequently suffer from neurological and vision disorders. In one study of pesticide illnesses in my state, California, cotton ranked third for total number of pesticide-caused worker illnesses.[17]

In many developing countries where environmental regulations are less stringent, the amount of pesticides, and their toxicity, is even greater, while workers are provided with even fewer safety precautions. The UN Food and Agriculture Organization points out that farmers in many developing countries use antiquated, dangerous equipment, which is more likely to result in spills and poisonings.[18] According to the Pesticide Action Network's Organic Cotton Briefing Kit: "In India, 91% of male cotton workers exposed to pesticides eight hours or more per day experienced some type of health disorder, including chromosomal aberrations, cell death and cell cycle delay . . . Pesticide poisoning remains a daily reality among agricultural workers in developing countries, where up to 14% of all occupational injuries in the agricultural sector and 10% of all fatal injuries can be attributed to pesticides."[19]

To top it all off, at harvest time the plants are sprayed with toxic chemical defoliants that strip off the leaves so they don't stain the fluffy white bolls and so the bolls are more accessible to the mechanical pickers or "strippers."[20]

We've now left the cotton fields, but we're still not even close to the finished product: my T-shirt. Taking the raw cotton and turning it into fabric requires a whole litany of industrial processes. The energy-sucking machines involved include a cotton gin that separates the fiber from the seeds, stems, and leaves, followed by machines that bundle the fibers into bales so they can be transported elsewhere, where more machines undo the bales, fluff the cotton, and press it into sheets called laps. Then come carding, combing, drawing, and spinning machines, which produce cotton thread. Finally weaving or knitting machines transform the cotton thread into fabric. But it's still not the soft, bright fabric of my white T-shirt. It needs to be "finished." This can involve "scouring," which means boiling the fabric in an alkali like sodium hydroxide to remove impurities.[21]

Next up: the color. Since my T-shirt is white, it's going to get an especially strong dose of bleach—but even colored T's get bleached before being dyed. (The dying process often uses benzene, heavy metals, formaldehyde fixing agents, and a whole host of chemicals, and because cotton naturally resists dyes, one-third of them run off into wastewater.) But back to my white one: to bleach its fabric, I can only hope hydrogen peroxide was used, but many companies outside the United States and Europe, where most garments are produced, are still likely to use chlorine.[22] Chlorine is toxic on its own, but if it gets mixed with organic (carbon-containing) material, as can happen once the chlorine leaves the factory in wastewater, it becomes a carcinogen and neurotoxin.

In the last stage before the fabric is trundled off to the sewing machines (or sometimes after it is sewn and assembled) it's usually treated to become what the textile industry calls "easy care," which means soft, wrinkle resistant, stain and odor resistant, fireproof, mothproof, and antistatic. Here we have one of the fabulous legacies of our post-1950s infatuation with science's capacity to "simplify" our lives. So which magic potion did scientists find would keep fabric so carefree? Formaldehyde.[23] This dangerous chemical (usually used as a building block of materials like resins and plastics) not only results in respiratory problems, burning eyes, and cancer, it can cause allergic contact dermatitis when it touches the skin.[24] Um, I don't know about you, but my clothes come into contact with my skin *all the time*. Other popular ingredients in this stage are caustic soda, sulfuric acid, bromines, urea resins, sulfonamides, and halogens.[25] These can cause problems with sleep, concentration, and memory . . . and more cancer.

Needless to say, it's not only we wearers of cotton whose health is at risk: factory workers processing the fabrics are especially impacted, and the contaminated wastewater from these factories ultimately affects the entire global food chain. In fact, about one-fifth of the global footprint of cotton consumption is related to pollution from wastewater from fields and factories.[26]

At last my T-shirt is ready to be born, and the finished cotton fabric is shipped off to the factory where this will happen. This is the stage we've heard the most about, on account of all the bad press that sweatshops have received. Sadly, despite the attention, the conditions for most garment workers are still horrendous. Many big brand clothing companies tend to seek out factories that pay the absolute lowest wages. Today this means places like Bangladesh and the "special economic zones" or "export processing zones" of China, where workers—squeezed into underlit, underventilated, deafening factories to perform mind-numbing, repetitive drudgery, sometimes for eleven hours a day—receive wages as low as ten to thirteen cents per hour.[27] Free speech and the right to form a trade union are routinely repressed as well. Child labor, though officially outlawed pretty much everywhere, still exists in shadowy pockets, most often employed when deadlines are tight.

When I visited Port-au-Prince, Haiti, in 1990, I met with women who worked in sweatshops making clothing for Disney. This was six years before the New York–based National Labor Committee released its 1996 film *Mickey Mouse Goes to Haiti*, exposing the hardships these workers face, but the plight of garment workers was already getting international attention and some of the women were nervous about speaking freely. Others weren't shy, hoping their stories would be heard by people like me who might be able to shift Disney's practices. Least shy of all was Yannick Etienne, the firebrand organizer from Batay Ouvriye ("Workers Fight"), who facilitated the meeting and translated the women's stories.

In the Haitian heat, we crowded into a tiny room inside a small cinderblock house. We had to keep the windows shuttered for fear that someone might see the workers speaking to us. These women worked day in and day out, sewing Disney apparel that they could never save enough to buy. Those lucky enough to be paid minimum wage earned about fifteen dollars a week for a six-day workweek, eight hours per day. Some of their overseers refused to pay minimum wage unless a certain number of garments were completed each shift. The women described the grueling pressure at work, routine sexual harassment, and other unsafe and demeaning conditions. Through international allies in the workers rights movement, they had learned that Disney's CEO Michael Eisner made millions. In the year that *Mickey Mouse Goes to Haiti* was released—1996—he made $8.7 million in salary plus $181 million in stock options, which comes out to $101,000 an hour.[28] In contrast, these women were paid *half of 1 percent* of the sales price of the garment in the United States.

Yet even with the horrible working conditions and starvation wages, the women feared losing their jobs, because they had no other opportunities. One told me that working for Disney allowed them to starve slowly, which was better than a quick starvation. The women wanted fair pay for a fair day's work. They wanted us to use our voice as U.S. consumers and citizens to pressure Disney into improving the wages and living conditions for the workers, so they could have a healthy, decent life. They wanted to be safe, be able to drink water when hot, and to be free from sexual harassment. The mothers wanted to come home early enough to see their children before bedtime and to have enough food to feed them a solid meal when they woke. Since that visit, I've never been able to look at Disney products without thinking of the women of Port-Au-Prince.

In August 2009, Etienne e-mailed me to say, "The working conditions have not changed much in the industrial park in PauP [Port au Prince]. We are still fighting for the same changes and now the battle for an increase of the minimum wage is waging fiercely."[29] It's been nineteen years since I first met the determined organizer and she is still fighting for worker rights in Haiti. In August 2009, the Haitian government did increase the minimum wage, but it still fell short of the five dollars a day that many workers were demanding. The new minimum wage is three dollars and seventy-five cents a day.[30] *A day!* Three dollars and seventy-five cents for a full day sewing our T-shirts and jeans and pajamas.

Back to my T-shirt: a final impact to consider is its carbon dioxide (CO_2) footprint, or its contribution to climate change. To grow the cotton for just my one shirt, about 2 pounds of CO_2 are generated—to make petrochemical-based fertilizers and pesticides, and for the electricity used in pumping irrigation water. The cleaning, spinning, knitting, and finishing processes add another 3 pounds. So in total my little T-shirt generates about 5 pounds of CO_2. That's *before* it gets transported to and from the store and then gets washed and dried over its lifetime, which at least doubles its carbon footprint.[31]

When I visited the website of the clothing company Patagonia recently, it allowed me to calculate the footprints of several of their items, including one of their organic cotton T-shirts. The site told me where "nearly half" of the cotton came from (Turkey); that's a long way away. The next stop listed

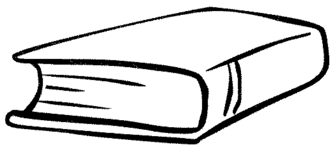
was Los Angeles, for knitting, cutting, and sewing in one factory and dyeing in another, using oil-based dyes, some of which are not PVC free. Patagonia explains: "Although plant-based dyes would seem to be more environmentally benign, they can be hard to harvest in sufficient quantity for commercial use. Plant-based dyes often lose their colorfastness after very few washings." Then the shirt was driven up to their distribution center in Reno, Nevada. According to their calculations, Patagonia's T-shirt travels about 7,840 miles and generates 3.5 pounds of carbon dioxide, even before it gets sent to your local store.[32]

Now, I don't mean to imply that organic cotton T-shirts (and other clothes) aren't worth the extra dollars you'll likely need to spend on them. Organic cotton avoids the use of pesticides and chemical fertilizers, which avoids the carbon involved in making those chemicals, keeps the groundwater and soil cleaner, and safeguards the health of animals and humans (farmworkers, residents of neighboring communities, and consumers). Organic farmers claim that the healthier soil (with the aerating services of earthworms that have not been killed by chemicals) causes less water to be lost in runoff, although biotech proponents say their genetically modified crops use less water. Factories like the ones Patagonia uses for the spinning, weaving, and sewing processes are at the forefront of energy conservation and also minimize toxic runoff. And if you see a fair trade logo, it means that the cotton farmers got fairer prices and the fabric workers got better than sweatshop conditions and were compensated more fairly than the women I met in Haiti.

For all these reasons, organic and fair trade cotton products are the better choice. But the best choice of all? Cherish the T-shirt you have. Wear it and care for it with the same persevering love you have for an heirloom piece of jewelry. Resist the urge to replace it with the newest color or neckline. I keep my T-shirts until they're too worn to wear even to the gym, and then I turn them into rags. It's what my grandparents did, and it's good enough for me. Because even though the price tag said $4.99, or even $12.99 at Patagonia, that doesn't come close to reflecting all the hidden costs of one plain white cotton T-shirt.

A Book

I have shelves and shelves of books. An entire wall in my bedroom is books. I have books on the kitchen counter, books spilling off my daughter's shelves, books piled by the unused fireplace. Books occupy an odd space in my relationship to Stuff: while I feel uncomfortable buying new clothes or electronics, I don't hesitate to pick up the latest recommended title. I asked my friends about it and found I'm not alone in feeling like books are somehow exempt from the negative connotations of too much Stuff. Do we feel the value of knowledge and creativity embodied by a book justifies its footprint? Do we just not think about the footprint? In writing this book, I realized that I knew far more about the environmental and health threats of my laptop, cell phone, or even my T-shirts than I did about the far more numerous books in my household. So I was eager to find out how books are produced.



Today, when we think of paper, we think of it coming from trees. However, paper has only been made from wood pulp since the 1850s.[33] Before then—and still to some extent today—paper was made from agricultural crops like hemp and bamboo, and from rags and old textiles. The word "paper" comes from the Greek word (*papyros*) for papyrus, a writing material they developed by mashing strips of the papyrus plant. The first known piece of paper was made almost two thousand years ago by a Chinese court official, Ts'ai Lun, who used mulberry bush fiber, old fishing nets, hemp, and grass. In the fifteenth century, some books were printed on parchment, which is made from the specially prepared skin of sheep or goats, or on vellum, made of calfskin. It took the skins of three hundred sheep to print one Bible back then. Later, in the sixteenth century, cloth rags and linen were also frequently used as the fiber in papermaking.[34] It wasn't until much later—around the mid-nineteenth century—that large-scale wood pulp processing was developed, allowing trees to become the primary source for fiber with which to make paper, and hence books. (Not every book today is made from plant fibers: One exception is Bill McDonough's book *Cradle to Cradle*, which was printed on plastic. E-books, of course, aren't printed at all.) Paper can also be made from previously used paper. That's recycling.

During all these hundreds of years, the basic steps of papermaking have remained the same. The fiber is mashed, flattened, and dried, and presto, you have paper. It's not unlike art projects I do with my daughter where we put old paper, flower petals, and wrapping paper scraps in the blender with water, whir it up, pour the slurry onto a window screen, squish it flat, and lay it in the sun to dry. Just four categories of ingredients are needed: fiber, energy, chemicals, and water.

But this simple list is a little bit misleading. First, of course, there's the problem of deforestation (see chapter 1 on extraction), including the less visible form of deforestation in which natural forests are replaced with

plantations. Today, nearly half of the trees cut in North America go to making paper for everything from newsprint to packaging to stationery.[35] Each year, about 30 million trees are used to make books sold in the United States.[36] To give you a visual, there are about 26,000 trees in Central Park,[37] so to make our books we use more than 1,150 times that number. Papermaking also uses vast amounts of energy and is among the top five emitters of greenhouse gases of all manufacturing industries.[38] It requires huge amounts of water and toxic chemicals, which get mixed and released together into the environment.

No matter which source you start with—virgin trees, managed forests, agricultural crops, or recovered paper—part of the substance is useful and part is not. The desired part is the fiber. What are not wanted are the lignin, sugars, and other compounds found in wood and other plants. If the source is paper that's being recycled, then most of the lignin is already removed, but the inks, staples, perfume inserts, and other contaminants have to be taken out.[39] Unfortunately, each time the paper goes through this process, the fibers get worn down and shortened, so they can't be recycled more than a handful of times.

The process of separating the useful fibers from the unwanted parts is called pulping. There are two main technologies used to make pulp: mechanical and chemical. Mechanical pulping involves chopping, grinding, or mashing the source material to separate the cellulose fibers from other compounds. Mechanical pulping is twice as efficient as chemical pulping, but the resulting fibers are short and stiff, which limits their use to a lower quality paper, mostly for newsprint, telephone directories (when was the last time you needed one of these?), and packaging.[40]

Chemical pulping, the more widespread process, takes chemicals, heat, and pressure to separate the fibers. More chemicals are used later in the process as dyes, inks, bleach, sizing, and coatings. "The art of modern papermaking lies in the specialty chemicals used," explained one chemical journalist. "Like spices for food, they give the paper that certain something."[41] And as paper use goes up, so does demand for those chemicals used in production. In the United States, the demand for chemicals for pulp and paper production is projected to reach 20 billion tons in 2011, with the chemicals valued at $8.8 billion.[42]

The most notorious and controversial chemical used in papermaking is chlorine, which is added to help with the pulping and also to bleach the paper. By itself, chlorine is a powerful toxin—so toxic that it was used as a weapon in the First World War. But when chlorine gets mixed with organic compounds (those that contain carbon)—which, in a slush made of mashed plants, happens a lot—the chlorine bonds with them to create nearly a thousand different organochlorines, including the most toxic persistent pollutant in existence, dioxin.[43] The U.S. Environmental Protection Agency and the International Agency for Research on Cancer have both confirmed that dioxin causes cancer.[44] It's also linked to endocrine, reproductive, nervous, and immune system damage[45]—which really don't seem worth it for having white paper. Me, I'd take slightly brown—or tree colored—paper over carcinogens any day.

In Europe, much of the paper—from toilet paper to book pages—is off-white in color. Many of their paper mills have switched to totally chlorine free (TCF) processes, using oxygen or ozone and hydrogen peroxide instead of chlorine to bleach paper.[46] In the United States and Canada, many of our mills prefer elemental chlorine free (ECF) processing, which replaces chlorine gas with chlorine derivatives, such as chlorine dioxide. True, this beats dousing our paper with chlorine gas, and it reduces dioxin formation by about half. But any amount of dioxins is too much, even a speck. So TCF is definitely preferable. There is one last variation on the chlorine front: processed chlorine free (PCF) refers to paper made from recycled paper sources. This means the mill can't guarantee that no chorine was used in the original paper production but promises that no chlorine was used in the recycling process.

Getting rid of chlorine requires some investment, but is a small price to pay compared to all those costs that get externalized onto the environment and people, such as the dioxin discharged into rivers that threatens fishing grounds, livelihoods, and community health.

One of the other toxins involved in papermaking is mercury, the potent neurotoxin that harms the nervous system and brain, especially in fetuses and children. Mercury has a backstage presence in papermaking, "upstream" at so-called chlor-alkali plants where chlorine and caustic soda (lye) are produced. The pulp and paper industry is the single largest consumer of caustic soda worldwide.[47] Even though competitive, cost-effective, nonmercury alternatives exist to making chlorine and caustic soda, a number of chlor-alkali plants in the United States and the rest of the world still use mercury in their manufacturing. And once it's been released into the environment, mercury doesn't go away.

However, things are looking up: there has been enough sustained concern about mercury (see the section "Dangerous Materials" later in this chapter) that these plants are increasingly becoming a relic of the past, gradually being replaced with mercury-free alternatives.

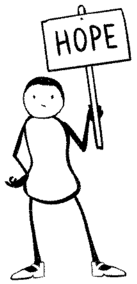
So, back to the paper mill. Once the pulping process is finished, the pulp is mixed with water and sprayed onto a moving mesh screen. These screens get vacuumed, heated, and pressed to get them to dry into a consistent paper product—all processes that consume energy. Now the paper is ready to be printed.

At the press, there's another slew of toxic petroleum-based chemicals added to the mix, which are used to make inks, clean the presses, and wash the so-called blankets (used to transfer ink-filled images to paper). At the top of the list comes toluene, which accounts for 75 percent of all toxic chemicals used in printing.[48] These chemicals get released into the environment at frightening levels. Many escape as vapors known as volatile organic compounds (VOCs), which not only smog up the air, causing respiratory, allergic, and immunity problems, but also drop into soil and groundwater.

There are viable alternatives to petrochemicals for inks and cleaners, however, in the form of vegetable-based "biochemicals." Although most are still made with some percentage of petroleum, they represent a huge improvement. They avoid a lot of the initial upstream pollution from the processes by which crude oil is extracted and refined into chemicals. They are much safer for workers at printing presses to handle and inhale and mean less investment in safety training and protective equipment. They are far less flammable. And they create far less toxic solid waste and emissions: while petroleum-based inks contain 30 to 35 percent VOCs, soy inks range from 2 to 5 percent.[49]

Soybean-oil-based inks have become the most popular of the vegetable-based inks and are now used by about one-third of the commercial printers in the United States.[50] Although they're priced slightly higher, soy inks turn out to perform better, producing brighter colors and requiring less ink to cover the same space, so they end up being more cost-effective than traditional chemical inks. They also make paper recycling easier, because they can be more easily removed from the old paper.

Once the pages are printed, they are stitched and/or glued together inside a hard cover (made of cardboard) or a soft paper cover. A final aspect of a book's footprint involves its distribution and shipping, which I'll examine in the next chapter.

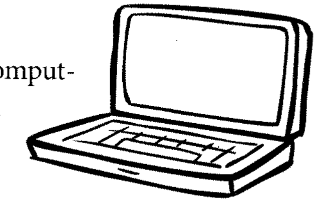


Thanks to the work of advocacy organizations such as the Environmental Paper Network and the Green Press Initiative, and to sustainable business leaders like Inkworks Press, EcoPrint, and New Leaf Paper, both the papermaking and the publishing industries have become greener. A lot more books are being printed on recycled paper stock, using fewer petroleum-based inks. When they are made in processes that have a lighter footprint, today's books often include a page explaining the source of the paper (recycled, virgin, from certified sustainable forests), the bleaching process, and the type of inks used, allowing readers a glimpse into the production process.

I took a look at the five books sitting on my nightstand as I wrote this. Two didn't mention their fiber source at all, leading me to assume the worst. One said its pages are "printed on recycled paper" but didn't provide specifics—what percentage recycled? Preconsumer (meaning trimmings from the paper factory that have never been touched by consumers) or postconsumer (meaning it was used and discarded by consumers)? Another confirmed its pages came from FSC-certified "well managed forests, controlled sources and recycled wood or fiber." The last book was made from postconsumer recycled content, which is a higher form of recycling than using preconsumer paper because it diverts would-be municipal waste back into useful products. Only one of my bedside books mentioned the chlorine issue, proudly displaying both the TCF logo on its cover and the PCF status of the interior pages.

When I was initially approached about creating a book based on the twenty-minute animated film of *The Story of Stuff,* I was a little bit reluctant, thinking of the resources it would involve. Yet thousands of people were asking me for more information about what I'd touched on in the film, wanting to hold discussion groups, create curricula, and learn more about positive alternatives to the current system and actions they could take. And, as I know from my travels around the world, there are still a lot of people in a lot of places who simply don't have access to the technology that would allow them to watch the film and access more detailed information online or as a DVD. So I agreed to do this book, but I held out for a publisher that committed to minimizing resources and toxic inputs in the book's production. You'll find an environmental impact statement for this very book on page 307.

My Computer



Collectively, Americans own more than 200 million computers, 200 million TVs, and around 200 million cell phones.[51] I do have a laptop and a cell phone, but the truth is, I'm one of those people who is just not attracted to new electronic gizmos. The incessant beeping annoys me, and the thought of losing all my contact information or documents in a single zap gives me hives. I staunchly rely on my fifteen-year-old refillable paper appointment book, which has accompanied me to at least thirty countries, even though each year that passes it becomes increasingly difficult to find replacement pages, an endangered species. I love this well-worn, very unhip appointment book so much that once I even entered an essay contest sponsored by the company that made it. The first stanza of the poem I composed read: "It doesn't light up; it doesn't plug in. It doesn't need batteries, has no secret PIN." I prefer it to high-tech alternatives for all those reasons.

But before you write me off as a total Luddite, let me assure you I appreciate the positive contributions that electronics and computer technology make. I would be hard-pressed to manage without my cell phone today. I know electronic devices can help find lost kids and stranded hikers. In the hands of activists around the world, they document human rights abuses and disseminate alerts and warnings. Text messages and tweeting have alerted the media and support networks when people have been unjustly detained or harmed. And I would be a very unhappy camper without my computer, which helps me find and organize information, communicate with friends and colleagues, and write this book.

Yet the story of our electronics is extremely complicated. Those Apple advertisements make their products look so clean, simple, and elegant, don't they? High-tech development is often cast as an improvement over the belching smokestacks of old-fashioned industries, but it actually just replaces the highly visible pollution of old with a less visible version.

The truth is, electronics production facilities are ecologically filthy, using and releasing tons of hazardous compounds that poison the workers and surrounding communities. Silicon Valley, less than fifty miles south of my home in Berkeley, has so many toxic contaminated sites linked to former high-tech development that it has among the highest concentration of Superfund sites in the country.[52] (Superfund is the U.S. government's list of sites so contaminated with toxins that they qualify for priority cleanup programs.) Much of the high-tech production has now moved out of Silicon

Valley—seeking the lower wages and less stringent worker safety and environmental regulations in Asia and Latin America—but it has left behind a toxic legacy.

The famed high-tech wonderland of Silicon Valley is also a place of social extremes, with the mansions where Internet tycoons live butting up against rundown neighborhoods inhabited by the people who actually make electronic components—or who used to before the factories moved overseas. As computer companies strive to offer lower prices to consumers while maintaining their hefty profits, they increasingly focus their cost-cutting efforts on the stops along the supply chain. Big name brand computer companies are infamous for pressuring manufacturers and suppliers to lower expenses and prices and to lengthen working hours in order to make and sell the components cheaply. Michael Dell of Dell computers once said, "Our job is to be absolutely the best in the world at driving costs down."[53]

Then there's the back-end problem of electronic waste, or e-waste. As I'll discuss further in the chapter on disposal, e-waste is a global nightmare, with between 5 and 7 million tons of electronics becoming obsolete each year, their trashed toxic components poisoning the land, air, water, and all of the earth's inhabitants.[54]

In trying to gather information about the specific materials that went into my computer and the processes by which it was made, I ran up against some insurmountable barriers. Ted Smith at the Electronics TakeBack Coalition shook his head when he heard that I wanted to uncover the story of my computer in the same way as I'd tracked the production of my T-shirt and this book. "A computer is more complex than those items by several orders of magnitude," he told me, like the difference between the biological makeup of, say, an earthworm and the entire planet. Smith points out that more than two thousand materials are used in the production of a microchip, which is just a single component of my machine! And because the industry moves so fast, continuously introducing new materials and processes, regulators and heroic watchdog groups like Smith's can't keep up. They haven't yet completed their analyses on the health and environmental impacts of electronics from several years ago, and a new crop of products has already been introduced.[55] On top of that, what makes telling the full story truly impossible is the secrecy the industry mandates, claiming their processes and materials are proprietary. That mentality is reflected in the title of a book by former Intel CEO Andy Grove: *Only the Paranoid Survive.*[56]

It is impossible to know the exact locations where all the components of a laptop were drilled for, mined, or made, because of the increasingly complex supply chain of the electronics industry, which the UN reports has the most globalized supply chain of all industries.[57] But we do know that all the problematic mining practices described in the chapter on extraction—for gold and tantalum, as well as copper, aluminum, lead, zinc, nickel, tin, silver, iron, mercury, cobalt, arsenic, cadmium, and chromium—are involved. The brand name company—Dell, HP, IBM, Apple, etc.—may have little immediate knowledge of, or even control over, how materials are derived or components are made, because these companies outsource to hundreds of other companies all over the world that provide and assemble the pieces. But that doesn't exonerate those big brands from their responsibility for the environmental contamination, health problems, or human rights violations that their products cause.

There *is* a fair amount of information available about the manufacturing of microchips, so we can at least take a look at how these are made. Chips, being the brains of the computer, are very complex. A chip is a thin wafer, usually made from silicon, onto which they etch tiny, fussy pathways made of metal that enable an electrical current to be transmitted and transformed into digital information. One of these chips is smaller than the fingernail of your pinky, and they're getting smaller all the time.[58]

The silicon for the wafers can be derived from nearly anyplace on earth; silicon is a kind of sand, very common and not inherently toxic. Fortunately wafer production does not require large amounts of silicon, which is good because exposure to silicon in mines or factories at greater levels can lead to respiratory problems and an incurable lung disease known as silicosis. According to the World Health Organization, thousands of people die from silicosis every year.[59] Later in the chip-making process, the toxic elements antimony, arsenic, boron, and phosphorus are added to make the silicon conduct electricity.[60]

To create the wafer, the silicon is ground to a powder, then dissolved in a flammable, corrosive, highly toxic liquid. In energy-intensive steps (there will be more than 250 of them before the chip is finished), this liquid is heated until it evaporates, is allowed to crystallize, and is baked again to form cylinders. The cylinders are cleaned and polished in a series of acidic and caustic solutions. Finally, the wafers are sliced from these cylinders. "Imagine a seriously high-tech, ultrapure silicon crystal roll of refrigerated cookie dough," writes Elizabeth Grossman in her comprehensive book *High Tech Trash*.[61]

It's onto these wafers that circuits will be etched, a process that involves another whole set of toxic metals, gases, solvents, and "etchants." "Altogether, one individual semiconductor fabrication plant may use as many as five hundred to a thousand different chemicals," writes Grossman, "acids, including hydrofluoric, nitric, phosphoric, and sulfuric acid, as well as ammonia, fluoride, sodium hydroxide, isopropyl alcohol, and methyl-3-methoxyproprionate, tetramethylammonium hydroxide, and hydroxyl monoethanolamine, along with acetone, chromium trioxide, methyl ethyl ketone, methyl alcohol, and xylene."[62] And that's only a partial list.

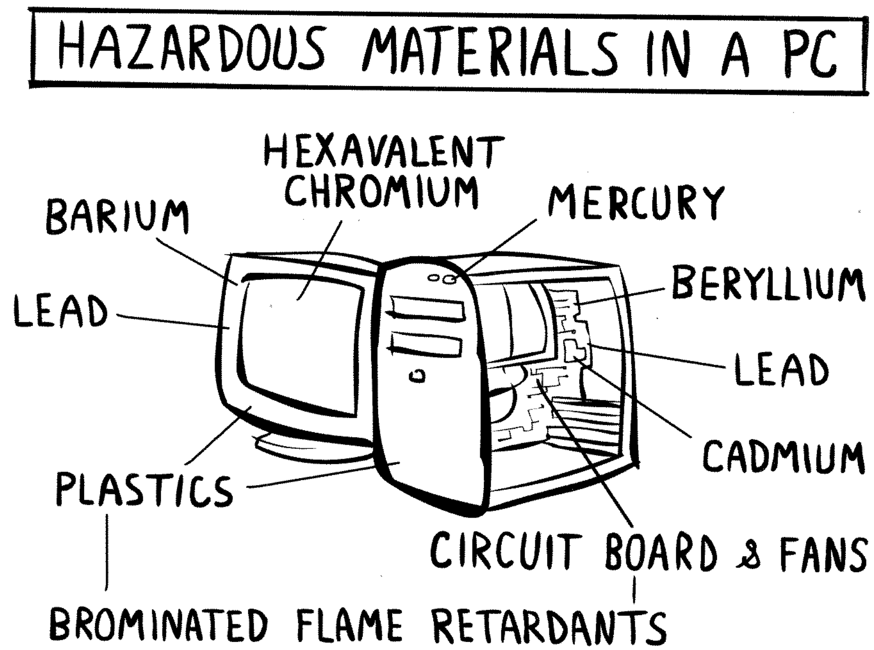
All of this takes place in so-called clean rooms, which use vast amounts of toxic solvents to keep microscopic particles of dust from landing on the chips. The term "clean" refers to protecting the product, not the workers. In fact, workers in clean rooms are among the most contaminated of all high-tech workers. The materials to which they're routinely exposed have been proven to cause respiratory diseases, kidney and liver damage, cancers, miscarriages, and birth defects like spina bifida, blindness, and missing or deformed limbs.[63] Many of these adverse health impacts likewise affect the communities around fabrication facilities, whose groundwater, soil, and air are contaminated.

And yes, the toxics threaten us even as we work on our computers. In 2004, two nonprofit organizations promoting safer materials in the electronics sector—Clean Production Action and the Computer TakeBack Campaign—collected dust from computers to test for the presence of toxic flame retardants. The scientists found these potent neurotoxins in every sample tested.[64] Flame retardants, such as PBDEs (polybrominated diphenyl ethers), are chemicals added to materials in an attempt to slow the time needed to reach ignition. But it isn't even proven that these chemicals deter flames: so they may not even help. When electronics that are encased in plastic treated with PBDEs heat up (as happens when a computer's been running for a few hours), the chemicals break off in the form of dust or as a gas that can leach out of the product into the environment (i.e., our desks).[65] The particular form of PBDEs used in computers persists in our bodies for years. Beyond their neurotoxicity, further studies have linked them to problems with immunity and reproductive systems, as well as to cancer, which is why PDBEs have been banned in Europe, are being listed under the Stockholm POPs Convention, and why computer manufacturers everywhere have come under pressure to phase them out.[66]

The public health implications of electronics production are matched by its impacts on the environment. Take the production of just one of these finished wafers, this tiny thing weighing in at about 0.16 grams.[67] According to Eric Williams of United Nations University, coauthor of the book *Computers and the Environment*, a wafer's production involves about 5 gallons (20 liters) of water, about 45 grams of chemicals—or more than 250

times the weight of the finished wafer—and enough energy to run a 100-watt lightbulb for 18 hours, or 1.8 kilowatt hours.[68] Additional energy is needed for the heating, cooling, and ventilation of the clean room. A factory making semiconductors can consume as much electricity in a year as ten thousand homes and up to 3 million gallons of water per day.[69] Annual utility bills can be as high as $20 to $25 million.[70] Finally, making a single chip results in 17 kilograms of wastewater and 7.8 grams of solid waste.[71] The wastewater contains a lot of nitrates, which in turn cause an explosion of aquatic plant growth in bodies of water that upsets the balance of ecosystems. Air pollution also results from the release of ammonia, hydrochloric acid, hydrogen fluoride, and nitric acid—toxins one and all.[72] And that's all just the microchips.

Then there's the monitor—the glass, especially in older models, often contains lead, the lights behind the flat-panel display often contain mercury—and the housing, which is composed of various petroleum-based plastics treated with flame retardants and other chemicals for color and texture. Noxious PVC, which I'll describe in more depth in an upcoming section, insulates the wires. The lithium batteries usually used to power laptops contain some toxic substances—for example, the lithium itself. These hundreds of materials, many of them hazardous, are all enmeshed and



Source: Silicon Valley Toxics Coalition/Electronics Take Back Campaign, 2008.

entwined, which is why recycling the components and materials from my laptop later, after its eventual disposal, will be such a hassle.

My laptop—the one on which I'm writing this book—was made by Dell. In 2006, when I was in the market for a new computer, I chose it because of Dell's high ranking in Greenpeace's regularly-updated *Guide to Green Electronics*, which rates electronics manufacturers on three areas: toxic chemicals, recycling, and climate change/energy consumption. Since 2006 Dell has dropped to a much lower ranking due to its backtracking on a commitment to eliminate toxic PVC and brominated flame retardants by 2010.

There's also some upsetting news in terms of worker safety at Dell. Their company policies discuss their commitment to ensuring safe working conditions, both at their own factories and for contractors that produce materials for Dell computers. Unfortunately, a number of investigations by labor and human rights organizations have found ongoing labor violations at factories producing for Dell. The Centre for Research on Multinational Corporations (SOMO), a nonprofit Dutch research and advisory bureau, investigated eight Dell suppliers in China, Mexico, the Philippines, and Thailand. SOMO uncovered "violations including dangerous working conditions, degrading and abusive working conditions, excessive working hours and forced overtime, illegally low wages and unpaid overtime, denial of the right to strike, discrimination in employment, use of contract labor and 'trainees,' workers without a contract, and lack of freedom of association and unionization."[73]

Uh-oh. Greenpeace's guide doesn't investigate working conditions. And who but a materials geek like me has time to do all this research and cross-referencing? Luckily, my colleague Dara O'Rourke, professor of environment and labor policy at the University of California, Berkeley, is creating an online tool called the GoodGuide, which provides wide-ranging information on the environmental, social, and health impacts of many thousands of consumer products all in one place. GoodGuide's section on electronics hasn't been launched as I write this (and O'Rourke's team is fighting against the same corporate firewalls I faced in researching my laptop).[74]

I don't want to portray Dell and other electronics manufacturers as totally resistant to change, though. They are attempting to lighten their environmental footprint by eliminating some environmentally sensitive materials like mercury, PVC and some toxic flame retardants; by increasing the percentage of renewable energy used to run their facilities; and by

reducing packaging and increasing the recycled content of packaging.[75] I applaud these efforts, but I'm afraid they just don't go far enough.

It seems ludicrous that electronics can't be made differently. Electronics designers and producers are smart people—it's mind-blowing how fast they come up with improvements in speed, size, and capacity. The oft-quoted Moore's law predicts that computing capacities can be doubled approximately every two years. So these guys can figure out how to fit thousands of songs on a device the size of a matchbook, but they can't eliminate the most toxic plastic—PVC—from their high-tech wonders or reduce packaging waste by more than 10 percent? Please! These brainiacs should be able to figure out how to phase out toxics, reduce waste to a minimum, and expand the durability and life span of their products too.

Environmental health activists tracking the industry have challenged the high-tech manufacturers to achieve the same level of improvement in environmental and health impacts as those Moore predicted for technical capacity. More than a decade ago, in May 1999, the Trans-Atlantic Network for Clean Production adopted the Soesterberg Principles, which added environmental, health, and social issues to the quest for technical innovation in the industry. The Electronic Sustainability Commitment of the principles reads:

> *Each new generation of technical improvements in electronic products should include parallel and proportional improvements in environmental, health and safety as well as social justice attributes.*[76]

If semiconductor capacity can double every two years, how about likewise halving the number of toxic chemicals and doubling the usable life span of these same devices every two years? Sadly, more than ten years since the Soesterberg Principles were adopted, technical improvements continue to get far more attention and make far greater progress than corresponding environmental and health improvements. And the vast majority of the environmental health advances that computer companies have made have only come after sustained campaigns by NGOs. Those NGOS—Silicon Valley Toxics Coalition, Clean Production Action, Electronics TakeBack Coalition, Good Electronics, Greenpeace, Basel Action Network, and others—are going to continue to work hard to press the electronics industry for improvements, but it would be a lot easier for us all if electronics producers embraced sustainability and social goals as seriously as technological and economic goals.

In the meantime, what I do is resist the impulse to trash my old electronics and replace them with the latest, shiniest versions. My appointment book and 2006 laptop do just fine.

Stupid Stuff

Some consumer products are so inherently toxic or wasteful or energy intensive that improving production just isn't a viable option and it would be better to just stop making and using them. If I could wave a magic wand and do away with two everyday items in order to have a huge positive impact on human health and the well-being of our planet, those two things would be aluminum cans and PVC. And if you're looking for some really easy, immediate things you can do to lessen your own impact, start by eliminating these two toxic and totally unnecessary materials from your life.

Platinum—I Mean *Aluminum*—Cans

As I was walking along in downtown San Francisco the other day, two enthusiastic promoters were handing out freebies of some new caffeinated drink. "Try it! It's fair trade! It's made with organic ingredients! It's good for you *and* the earth!" I declined the offer and decided not to rain on their feel-good parade by telling them what a joke it is that a fair-trade organic drink is packaged inside one of the most energy-intensive, CO_2-producing, waste-generating products on the planet: a single-use, single-serving aluminum can.

In the United States we consume about 100 billion cans per year, or 340 per person: almost one a day. That's ten times more than the average European and twice as many as the average Canadian, Australian, or Japanese. In places like China and India, people are only consuming about 10 cans per person per year on average (with wide disparities between social classes), although that number is expected to rise as their economies explode.[77] People like cans because they're light, they don't break, they chill quickly, and they have a reputation for being widely recycled. If the real story were more widely known, people might stop using aluminum cans so carelessly.

A can starts its life as a reddish ore called bauxite, which gets strip-mined in Australia, Brazil, Jamaica, and a few other tropical spots.[78] The mining displaces native people and animals and cuts down legions of those brave soldiers in the war against global warming—the trees.

The bauxite is transported elsewhere to be washed, pulverized, mixed with caustic soda, heated, settled, and filtered until what's left is about half

the weight of the original ore in aluminum oxide crystals. But something else is left over: a waste slurry known as "red mud," made of the extremely alkaline caustic soda, as well as iron from the bauxite. The mud is often just held in huge open-air pools.[79] Were a major storm to flood these reservoirs, the environmental damage to the surrounding environment would be devastating. Incidentally, we could be using the iron in that sludge, but no one has figured out an economical way to extract it yet.

Next, the aluminum oxide is transported to smelters, and this is where the truly gross aspects of aluminum production kick in. There's a reason scientists call aluminum "congealed energy": making one aluminum can takes energy equivalent to one-quarter of the can's volume in gasoline.[80] Aluminum smelting requires more energy than any other metal processing on earth.[81]

At the smelter, the aluminum oxide crystals are dissolved in a bath of something called cryolite (sodium aluminum fluoride) and zapped with enormous jolts of electricity (100,000 to 150,000 amps), which strips the oxygen from the aluminum. This process also breaks off bits of the fluorine from the cryolite, which escapes the smelter in the form of perfluorocarbons (PFCs)—these are the most noxious of greenhouse gases, trapping thousands of times more heat than carbon dioxide. What remains is pure aluminum, which gets poured into molds and cooled into bars. Then these bars are shipped elsewhere, rolled into super-thin sheets, and shipped to another factory that punches and forms those sheets into cans. They are washed, dried, primed, painted with the brand and product information, lacquered, sprayed inside with a noncorrosive coating, and finally filled with a beverage.[82]

After all that, the can's contents are consumed in a matter of minutes, and the can is trashed in a matter of seconds. "I don't understand my countrymen. They import this product, drink the garbage, and then throw away the valuable resource," says Puerto Rican activist Juan Rosario, bemoaning the high levels of soda consumption and low level of recycling on his island.[83]

Globally, about a third of aluminum smelters use coal-generated electricity. In addition to carbon dioxide emissions, this pollutes our air with tons of carbon monoxide (the gas that'll kill you if you leave your car running in a closed space), sulfur dioxide, and nitrogen dioxide.[84]

Most of the smelters in the United States and other developed countries have been shut down, and those that are still operational probably won't be up and running much longer. Since 20 to 30 percent of aluminum's total production cost is electricity, while the transportation costs from mines to refineries to smelters constitutes less than 1 percent,[85] it's common to ship the raw materials around the world to take advantage of the cheapest power. Rio Tinto, a huge Australian mining concern, has plans for a new smelter in Abu Dhabi.[86] Why there? Because now that Australia's coming on board with international carbon emissions policies (the Kyoto Protocol's follow-up), that old coal-fired plant will become too expensive, while Abu Dhabi will remain a carbon free-for-all zone.

Worldwide, smelters in rich countries where energy is becoming more expensive are being abandoned in favor of building new ones (plus the power plants needed to fuel them, usually dam projects) in farther-flung places like Mozambique, Chile, Iceland, and along the Amazon River in Brazil.[87] Construction of the dams, roads, and other necessary infrastructure (plus the waste and emissions once the plants are up and running) seriously threatens lives—human, animal, and vegetable—and the climate. For example, a planned site in Iceland would flood a pristine area that contains more than one hundred breathtaking waterfalls and habitat for reindeer and other vulnerable wildlife.[88] Glenn Switkes, the Amazon Program Director of International Rivers, an organization dedicated to protecting rivers around the world, explains that aluminum companies are the principle force behind the Brazilian government's plans to dam the major rivers of the Amazon: "Aluminum companies are relocating to the tropics because governments in developing countries are providing them with subsidized hydroelectricity. These dams have irreversible impacts on biodiversity, and displace thousands of riverbank dwellers and indigenous peoples."[89]

What's that? You're waving the white flag of recycling? Well, the fact is, all the attention paid to recycling in the past few decades has given Americans an inflated idea of how much aluminum is being recycled. That, and some clever manipulation of the numbers by the aluminum industry.*

While it's true that cans are 100 percent recyclable, aluminum recycling in the United States has been on the decline for decades. We're recycling

* There are inconsistencies in calculations of the "recycled" sources of the aluminum supply. The U.S. Geological Survey, for example, differentiates between "old," or postconsumer, scrap, and "new," or preconsumer, scrap, which consists of leftover shreds from the production process that never leave the factory. The Aluminum Association, an industry trade group, lumps these streams together in its calculations, which gives the impression that a higher percentage (close to a third) of aluminum comes from "recycled" (or "recovered") sources, when in truth real recycling (postconsumer) accounts for less than one-fifth of the supply. (Jennifer Gitliz, *The Role of the Consumer in Reducing Primary Aluminum Demand*, a report by the Container Recycling Institute for the International Strategic Roundtable on the Aluminum Industry (São Luís, Brazil, October 16–18, 2003, p.9).

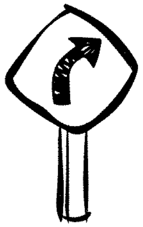
about 45 percent of cans today, down from 54.5 percent in 2000 and the peak rate of 65 percent in 1992.[90] In part this is because Americans are spending ever more time commuting and consuming beverages on the go, while there are few recycling bins in places away from home like the mall, the movie theater, the airport, etc. It's also because we still only have bottle bills, which place a 2.5- to 10-cent deposit on each can and bottle, in a mere ten states across the country.[91] In Brazil, meanwhile, there's an impressive 87 percent recycling rate for beverage containers because many people rely on the income from collecting them.[92] Given rising levels of unemployment stateside, you'd think we might follow Brazil's example.

As the Container Recycling Institute points out, widespread subsidies for virgin aluminum also detract from recycling: "Because of long-term, cut-rate energy contracts, below-market water rates, the easy acquisition of government lands for mining, and a myriad of tax breaks and infrastructural assistance, aluminum companies have perhaps been less vulnerable to global economic forces than some other primary industries. [This has] enabled the world aluminum primary industry to expand capacity ahead of demand. As long as excess primary aluminum production capacity exists on the global market, and as long as the cost of making virgin ingot remains low, scrap prices will remain suppressed."[93]

In fact, it's estimated that more than a trillion aluminum cans have been trashed in landfills since 1972, when records started being kept. If those cans were dug up, they'd be worth about $21 billion in today's scrap prices.[94] In 2004 alone, more than 800,000 tons of cans were landfilled in the United States (and 300,000 tons in the rest of the world).[95] As a Worldwatch report pointed out, "that's like five smelters pouring their entire annual output—a million tons of metal—straight into a hole in the ground. Had those cans been recycled, 16 billion kilowatt hours could have been saved—enough electricity for more than two million European homes for a year."[96]

I saw a great depiction of the irrationality of aluminum beverage cans when I was working on waste issues in Budapest in 2007. HuMuSz, an organization there that raises awareness about waste, had made a series of short, entertaining films that play before feature films in Hungarian movie theaters. My favorite film took place in a *WALL-E*-like, totally trashed planet Earth of the future, where aliens arrive to conduct research. They find one remaining human being and grill him for answers about the incredibly valuable and widely dispersed pieces of aluminum strewn about the planet, convinced these were used for communications, military, or medical purposes. When the human replies that they were for single-use servings of sugary, carbonated drinks, the aliens berate him for lying:

"No one would be so stupid, so irrational to use such a highly valuable, energy-intensive metal to hold a simple beverage!" I'm with the aliens on this one.



For once, the solution is incredibly straightforward. If we cut out the absurd, frivolous use of aluminum as a container for our beverages, we can put the tons of aluminum already in circulation into Stuff that makes sense, like to replace some steel to lighten up our modes of transportation, especially while these are still running on CO_2-spewing fossil fuels. And instead of disposable cans, we could be drinking out of refillable bottles, which will take a little advance planning but will cut air and water pollution, energy use, and the production of CO_2 and waste.

PVC, aka Pernicious Vile Compound

Plastic is pretty much universally recognized as a problem these days, from the oil needed to produce it to the virtually immortal debris it leaves floating in our oceans. But not all plastics are created equal; some are more problematic than others. PVC plastic (polyvinyl chloride), commonly referred to as vinyl, is the most hazardous plastic at all stages of its life: from its production in the factory; to its use in our homes, schools, hospitals, and offices; to its disposal in our landfills or, worst of all, our incinerators. It's also a cheap and versatile plastic, which are two reasons it continues to be widely used in spite of its negative environmental health impacts.

PVC has a variety of forms and textures and shows up in all kinds of places: fake leather shoes and purses, waterproof raincoats and boots, shiny bibs and aprons and tablecloths and shower curtains; garden furniture and hoses; food containers and wrapping; plastic-coated dish drying racks; vinyl siding and windows and pipes. It's in medical supplies (tubing) and office supplies (binders). And it's all around our kids in their toys and clothes.

Again we see toxic chlorine, which shows up in much of our Stuff. During PVC's multistage production, chlorine gas is used to produce ethylene dichloride (EDC), which is converted into vinyl chloride monomer (VCM), which is converted into the PVC.[97] This is a horrifically poisonous list of ingredients. Many studies have documented high rates of diseases among workers in vinyl chloride production facilities, including liver cancer, brain cancer, lung cancer, lymphomas, leukemia, and liver cirrhosis.[98]

PVC's production process also releases a lot of toxic pollution into the

environment, including dioxins. As I've mentioned, dioxins are a group of noxious chemicals that persist in the environment, travel great distances, build up in the food chain, and then cause cancer, as well as harm the immune and reproductive systems.

Additionally, because in its pure form PVC is actually a brittle plastic with limited use, further chemicals, or additives, need to be mixed in to make it pliable and expand its uses. These include neurotoxic heavy metals, like mercury and lead, and synthetic chemicals, like phthalates, which are known to cause reproductive disorders and are suspected to cause cancer.[99] Since most of these additives don't actually bond to the PVC at the molecular level, they slowly leak out, a process called leaching or off-gassing. Sometimes quickly, sometimes slowly, these additives seep out of the PVC plastic, migrating from toys into our children, from packaging into our food, and from our shower curtains into the air we breathe.

In 2008, the Center for Health, Environment and Justice (CHEJ) released a study testing toxic chemicals that off-gassed from a new PVC shower curtain. CHEJ's tests found 108 different volatile compounds released from the shower curtain into the air over twenty-eight days. The level of these compounds was sixteen times in excess of the indoor air quality levels recommended by the U.S. Green Building Council.[100]

But before you start a massive PVC purge of your surroundings, consider the last part of PVC's miserable lifecycle: its disposal. We Americans toss out up to 7 billion tons of it per year, with 2 to 4 billion tons of that going to landfills.[101] When PVC winds up in a landfill, it leaches its toxic additives into the soil, water, and air.

Dumping PVC is bad, but burning is even worse, since burning PVC produces the super toxin dioxin.[102] Despite this fact, much burning of PVC isn't accidental. It generally gets burned in one of four places: backyard or open burning, medical waste incinerators, municipal waste incinerators, or copper smelters (often scrap wire is coated in PVC, so burning to reclaim the copper inevitably also burns more PVC[103]). Also, as more PVC is used in construction materials, building fires have become a new source of dioxin and other toxic emissions. When PVC building materials heat up in fires, they release toxic hydrogen chloride gas or hydrochloric acid, which is deadly if inhaled by firefighters and others trapped inside.[104]

And what about recycling? There's that white flag again, eager to quell our concerns about using too much Stuff and making too much waste. With PVC, recycling simply isn't a solution: it just adds to the problem, because recycling a poison perpetuates the hazard and exposes yet another round of workers and future consumers. The only answer is to stop making new PVC and get the existing PVC out of circulation.

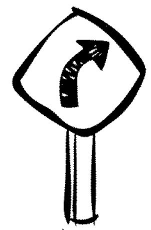
So what to do with the PVC you do have? First off, don't beat yourself up if it's around you and your family: even in my household, despite my vigilance, insidious PVC infiltrates. Sometimes it arrives in the form of small toys in goodie bags my daughter brings home from birthday parties. Occasionally I get something, like the new extension cord I just bought, that I didn't realize was PVC until I opened the package and its stench filled up the garage. Once I ordered a rain jacket for my daughter; again, although the online description didn't say it was PVC, its odor did. So what to do? In all of these cases, I pack up the product and send it back to the manufacturer with a letter explaining why the product is unacceptable, giving them the rundown on PVC, and demanding a refund. (There's a sample letter in appendix 3 you are welcome to copy). If I can't identify the manufacturer, the offending product goes into a box in my garage that, when full, I mail off to the Vinyl Institute, an industry trade group in D.C. (Their address is also in appendix 3.) Since these guys make big bucks to defend the producers of PVC, I figure they can deal with it. You could also invite your neighbors to send theirs back with yours, and if you get enough people to participate, invite a local TV, radio, or newspaper reporter. The more we can raise awareness about how unacceptable PVC is, the better.

As for avoiding future PVC purchases, this material isn't too hard to identify. The two easiest clues are the label and the smell. If you turn a plastic container over and find a number 3 inside the little chasing-arrows recycling logo, put it back on the shelf.

If you can, make a quick call to the customer service number on the container, or send an e-mail or letter when you get home, telling the company you're not buying their Stuff as long as it's packaged in the most toxic plastic on the planet. Some containers don't display the number but say "vinyl" or "PVC" or may even have just a little "V." Look carefully. It's worth the extra minute to make sure you're not bringing PVC home.

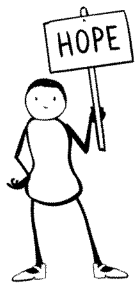
The other way to identify PVC—often from yards away—is the smell. You know that smell of a new shower curtain, a new car, or the shoe section at a Target store? That is PVC. Or more accurately, it's some of the additive chemicals that are off-gassing. At a Halloween-time birthday party my daughter attended recently, plastic vampire fangs were handed out as favors. As soon as she got a whiff of them, she started running around the party grabbing them from the other kids, yelling, "Don't put them in your mouth!" In other words, even your kids can be on guard against it. If you

think this is a sad situation to put our kids in, you're right. It stinks—both in terms of odor and in terms of whoever made the decision to use this supertoxic material when safer alternatives exist.



It's more of a challenge to figure out how to get all the PVC pipes out of our houses, but we can easily eliminate the packaging, plastic bottles, and containers, as well as all the junky vinyl Stuff PVC is so often used for, like plasticky backpacks or inflatable kiddie pools. There are safe, cost-effective alternatives to so much PVC crap! In my bathroom, I have a cotton shower curtain that I can launder. In my kitchen, I use sturdy reusable containers instead of ever letting my family's food touch that foul plastic wrap.

Unfortunately, other choices are harder to make. For example, when I wanted to replace three old windows in my house with more energy efficient ones, I found that the price of PVC window frames is about half that of traditional wood. Knowing about PVC's lifecycle, I know that the true costs of producing those PVC windows include nearly insurmountable health and safety impacts, while wood window frames can be made from sustainably harvested or salvaged wood and can be painted without heavy metals or other toxics. The PVC windows just *seem* cheaper because someone else (the workers, the fence-line communities, the environment) is paying the real costs. My current solution is to just make do with some less-than-perfect-looking window frames for a few more years and to install far less expensive insulating curtains instead.



As more people learn about the dangers of PVC and refuse to buy it, some companies are beginning to respond. Organized consumer-citizens have pressured Bath & Body Works, Honda, IKEA, Johnson & Johnson, Microsoft, Nike, Toyota, Victoria's Secret, and even Wal-Mart to commit to phasing out PVC at different levels. While I am glad every time these organizers add another store to their victory list, I don't think we can solve this problem going store by store, forcing each one to stop using PVC. We simply don't have time. We need a combination of leadership from within the business community, strong citizen watchdog groups, and government action to stop PVC at its source.

Sweden, Spain, and Germany have all restricted PVC in some locations or uses. In Spain, more than 60 cities have been declared PVC free, and 274 communities in Germany have enacted restrictions against PVC.[105] Many government actions have focused on the specific concern about endocrine-disrupting phthalates in PVC toys, in response to which some restrictions or bans have been adopted by the European Union, Japan, Mexico, and elsewhere.[106] Meanwhile, the United States has not even considered a national ban, opting instead for a *voluntary* agreement with manufacturers to remove two phthalates from PVC rattles, teethers, pacifiers, and baby bottle nipples.[107]

Can you detect the problems with this approach? First, every parent knows that kids don't limit their playthings to items labeled as "toys." Second, we can't limit our concerns to children: that leaves the rest of the population exposed to phthalates as well as all the other toxins in PVC. The only solution is to go 100 percent PVC free, as quickly as possible.

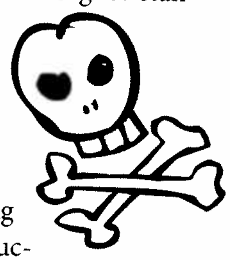
Key Questions About Production

By investigating just these five items, we start to get a sense of how production plays out. Even with Stuff that seems simple, there are a mind-blowing number of ingredients, machines, by-products, not to mention impacts on the environment and human health. Imagine what goes into making your car or home.

Therefore, before buying anything, I've developed the habit of asking myself: Is all the effort to extract ingredients for and produce this thing, combined with my hours of work to pay for it, worth it? Can I borrow one from a friend? Deborah loaned me a baking pan for last Thanksgiving dinner. Andrea loaned me her pickup truck to move furniture. Nick loaned me his ladder. I loaned Jane my extra-warm down coat when she went back east last January. The benefits to borrowing and lending aren't just environmental, they're social as well. It's fun, and it builds community.

Of course there are times when I do need or want to purchase something new. In that case there are a couple key parts of the production process that I focus on. I ask: Were toxic ingredients used to make it? What was it like to be one of the factory workers who helped create it? Was any part of the production so distasteful that rich countries with higher standards refused to do it?

Here's a little of what I've learned along the way by asking those very questions.



Dangerous Materials

Industrial production facilities today use a mind-boggling array of hazardous chemicals. Some are part of the production process, like solvents employed for diluting other compounds, or cleaning and drying machinery, while others are mixed into the product, like lead or phthalates, which help to create a certain texture or color.

Chemists and industrial designers and activists use all sorts of complicated systems to classify materials. But I figure that what's really important to us as individuals is whether or not any of the materials used in our Stuff are dangerous. So although it's unorthodox by scientific standards, I'm going to lump all the toxic materials together—heavy metals mined from the earth, like lead, cadmium, arsenic, chromium, and mercury, alongside synthetic organic compounds, like the organochlorines (dioxin, DDT), perfluorooctanoic acid (PFOA, used as a water repellant), and polybrominated diphenyl ethers (PBDEs, the flame retardants).

Another term you'll frequently hear is POPs, or persistent organic pollutants. To decode that: "Persistent" means they don't break down. They stay inside the tissues of living creatures, often bioaccumulating, which means they lodge in fat cells and get passed up the food chain at ever-increasing concentrations. "Organic" means they contain carbon, which means they can interact with the cells of living things (all of which contain carbon) in a variety of insidious ways. "Pollutant" means that they're toxic—disruptive to the endocrine, reproductive, and immune systems and also a source of neurobehavioral disorders.*

Let's look at the naturally occurring heavy metals. Even though these all occur in nature, the scale at which we're extracting them, putting them into consumer goods, and distributing them around the planet is unnatural and devastating. As a case in point, global emissions of lead from industrial sources are twenty-seven times higher than lead emissions from natural sources.[108] There's a reason nature secured these metals underground rather than circulating them in biological systems: they are supertoxic to all life forms. Scientists have amassed piles of studies concluding beyond a doubt that even low-level exposure to these chemicals is causing widespread neurological, developmental, and reproductive problems. Many of the heavy metals are biopersistent, which means that once they are inside a living organism, they remain there for a really long time—we're talking decades—before passing out of the body. Many of them also bioaccumulate.

Lead, for example, is a neurotoxin, which means it poisons the brain and

* POPs are so bad that a United Nations Convention was created to target them, outlawing some and severely restricting others. To start with, the Stockholm Convention identified twelve top-priority POPs: eight pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, and toxaphene); two industrial chemicals (the hexachlorobenzenes (HCBs) and the polychlorinated biphenyls [PCBs]); and two groups of industrial by-products (dioxins and furans). In May 2009, additional chemicals were included: HCH/Lindane, HBB, Penta and Octa DBE, Chlordecone, PFOS and pentachlorobenzene. Source: Stockholm Convention on persistent organic pollutants, http://chm.pops.int.

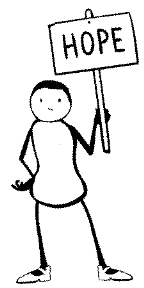
the nervous system. It's been linked to learning disabilities and reproductive disorders. "We've learned that virtually any level of lead is associated with neurodevelopmental impacts. It's a continuous impact beginning from non-zero levels and on up. So, for any of us, if we are exposed to lead, there's an impact. It may be small in the lower exposure range, but it's there," says scientist Ted Schettler of the Science and Environmental Health Network.[109] In spite of this, lead is still in widespread use in Stuff like car batteries, PVC plastic, roofing materials, lipstick, and toys. In their 2007 study, the Washington Toxics Coalition found lead in 35 percent of 1,200 children's toys tested, with 17 percent of the products containing lead levels above the 600 ppm federal recall level for lead paint.[110] Brain-harming poison in children's toys: it sounds like a bad horror movie, except it's real.

Another notorious toxin we surround ourselves with is mercury. There is a reason my mother warned me not to touch the irresistible silver liquid that oozed out of broken glass thermometers. Mercury exposure impairs cognitive skills; in large doses it messes with your lungs and eyes and can cause tremors, insanity, and psychosis. It's also been linked to cancer, cell death, and diabetes.[111] Children and babies are especially vulnerable to mercury because their nervous systems are still developing. A baby exposed to mercury in the womb can be born with neurological problems, physically deformities, or cerebral palsy. The United States government estimates that more than 15 percent of children born in the United States could be at risk for brain damage and learning difficulties due to mercury exposure in the womb.[112] According to a 2005 study, the IQ of 316,000 to 637,000 children per year is lowered by mercury exposure.[113]

We've heard a lot about mercury contamination from fish in recent years. Already in my daughter's kindergarten, these tiny kids matter-of-factly explained to one another that they couldn't have any tuna fish sandwich because they'd already had one that week. The reason that mercury in fish is such a big deal is that when mercury emissions from factories, coal-burning power plants (which provide power for the factories), and incinerators (which burn the Stuff made in factories) sink into the sediment of lakes, rivers, and oceans, anaerobic organisms turn those emissions into methylmercury.[114] This form of mercury is a far more powerful toxin than even the original mercury, and it bioaccumulates, meaning it builds up from small fish to larger and larger ones, with concentrations becoming much higher near the top of the food chain, ending with humans.

While it's true that we metabolize and move mercury out of our bodies, the ubiquity of it means we're re-exposing ourselves and taking in more every day. There's also significant disparity between individuals as to how

fast that clearing-out process can go—for some people it's 30 to 70 days, but for others it can be nearly 190 days![115] The difference in clearing time appears to be written in your genes, and until the brand-new field of envirogenetics (which studies the interplay of genetics and environmental factors like diet or toxics exposure) matures, it's hard to know what your body's mercury timeline is.



Meanwhile, government warnings and stark statistics about mercury-contaminated fish have become so routine that we barely take note. I have to ask: why have these warnings been aimed at getting people to cease eating fish, rather than at getting the industries to stop putting mercury into our environment? Finally in February 2009, near-global consensus was reached: more than 140 countries convened by the United Nations Environment Programme (UNEP) unanimously agreed to create an international mercury treaty. They also urged immediate action through a voluntary Global Mercury Partnership while the treaty is being finalized.[116] Getting mercury out of our production processes will be hard work and it will cost money, for sure. But investments in eliminating mercury are investments well spent. UNEP estimates that every kilogram of mercury taken out of the environment can lead to up to $12,500 worth of social, environmental, and human health benefits.[117]

It's high time, because about 6,000 tons of mercury are released into our environment every year.[118] Some of this is a by-product of a primary process, as with coal-fired plants, chlor-alkali plants involved in papermaking, and the especially stupid practice of burning municipal waste. But much is also released consciously in the primary process—in gold mining, as I mentioned in the last chapter, as well as in the manufacture, use, and disposal of medical equipment, fluorescent and neon lighting, dental amalgams, vaccines and other pharmaceutical products, and even mascara. Yes, mascara.

Synthetic Offenders

In addition to the naturally occurring heavy metal poisons, there are the synthetic ones. While synthetic compounds have been made since cavemen experimented with mashing materials together, the large-scale development and use of synthetics has really exploded since the mid-twentieth century. Sometimes the drive to invent new materials has come from a specific requirement for the product, such as the need for paint that won't wash off in the rain. Other times the production of synthetic compounds has been motivated by the need to find a use for the by-product of another

THE MAKEUP OF YOUR MAKEUP

I'm not huge on makeup, perfume, or "beauty products" myself. Maybe you are, and maybe you're not. But at the very least I bet you use soap, shampoo, conditioner, and lotion. I do. Collectively this Stuff is also known as personal "care" products—but I put "care" in quotes because it's pretty questionable how much "caring" is going on here.

Here we are, rubbing these products into our pores, sometimes on our lips and eyes. So what's in them? A lot of nasty surprises and industry secrets is what. Have you ever turned your shampoo bottle or tube of sunscreen around to read the ingredients? Once you get your magnifying glass out, it might as well be written in Klingon, right?

It turns out that every day of her life, the average American woman uses a dozen products that contain 168 chemical ingredients. The average guy is using six products a day, with 85 chemicals in them—with the use of products among men rising.[119] Whether they're drugstore purchases, indulgences from the ritziest cosmetics counter, or even "natural" and "organic" products from your local health food store, they're almost certain to contain hazardous chemicals.

A 2005 study of thousands of personal care products found that:

- One-third of them contained at least one ingredient linked to cancer
- Nearly half of them contained an ingredient that is harmful to the reproductive system and to a baby's development
- 60 percent of them contained an ingredient that mimics estrogen or can disrupt hormones
- More than half of them contained "penetration enhancer" chemicals, which help other chemicals move into the body deeper and faster.[120]

By law, companies are allowed to keep their trademark scents a secret; they show up on ingredient lists as the mysterious "fragrance." One example of what's lurking behind the word are phthalates—proven to disrupt the production of testosterone and cause babies of contaminated mothers to be born with malformed and malfunctioning testicles and penises.[121] Even with what we know about these chemicals, in 2002 researchers still found (unlabeled) phthalates in three-quarters of the seventy-two products they randomly tested, including hair spray, deodorant, hair gel, body lotion, and perfumes.[122]

Other surprises: as the Campaign for Safe Cosmetics put it in a Valentine they sent me last February, "Roses are red, Lipsticks have lead . . ." In 2006,

random tests of lipsticks (again, at all price ranges) found lead at two to four times the levels permitted by the FDA for candy.[123] There is absolutely no reason a product that gets applied, eaten away, and then reapplied to our lips should have a neurotoxin like lead in it! Meanwhile, *baby* shampoos often contain a carcinogen called 1,4-dioxane—it's in most adult shampoos too, often hidden as an ingredient called sodium laureth sulfate.[124]

There are particular dangers for specific populations, too. Nail salons overflow with potent toxins; the women who work in them are overwhelmingly nonwhite, often Asian, with an average age of thirty-eight—which means many are of childbearing age.[125] The skin-whitening products so popular in Asia frequently contain a carcinogen called hydroquinone, as well as the heavy metals chromium and mercury.[126] And the hair relaxers aggressively marketed to African-American women are very toxic. Products that change the shape and color of your hair are right up there at the top of the most hazardous list.[127]

Isn't someone regulating this Stuff? The 2005 study found that 87 percent of ingredients have not been assessed for safety by the Cosmetic Ingredient Review (CIR) panel.[128] Now, the CIR is the *only* body responsible for testing the safety of these products. The FDA doesn't have the authority to require companies to do safety tests; it can't even recall personal care products when they've been proven to be defective or harmful! As it turns out, the CIR is funded and run by the cosmetics industry through its trade association, the Cosmetic, Toiletry, and Fragrance Association. Their tests focus on immediate health effects like rashes and swelling. Unfortunately, they really need to test for long-term effects, as well as what happens when different chemicals interact with one another and with genes.

This information gets overwhelming fast. Thank goodness some activists have created powerful resources that enable us to inform ourselves and to push for change. The Environmental Working Group created and maintains Skin Deep, a huge database of more than forty thousand products and their ingredients.[129] You can enter in the name of many cosmetics and personal care products and find out what's in them. Visit their site at cosmeticsdatabase.com so you can avoid as many chemicals as possible, especially if you are pregnant or planning on getting pregnant.

You can also look out for companies that have signed the Compact for Safe Cosmetics, a pledge to replace ingredients linked to cancer, birth defects, and hormone disruption. More than one thousand companies have signed it to date.

chemical reaction or industrial process (often the refining of petroleum and natural gas). This type of material is often called a sink—someplace to pour what you don't want.

For example, in making ethylene, which is needed to produce the plastic product polyethylene, the by-product propylene is created. If this by-product can be put to use as a sink, or a raw material for something else, the cost of making ethylene goes way down. So inventors cast around for something to do with propylene and discovered it can be turned into something called acrylonitrile, which can be made into those acrylic outdoor carpets. And so acrylic outdoor carpeting was born as a substitute for natural ground covers.[130] It's not like we needed a replacement for mosses or grass and set our most brilliant minds to come up with one. Instead there was a strange backward development process, driven by profit.

TOXINS GET PERSONAL

In the summer of 2009, I had my own "body burden" tested to find out which of the chemicals that I'd been investigating for years were present in my own body.[a] The testing was organized by Commonweal's Biomonitoring Resource Center and the results were analyzed by Dr. Ted Schettler from the Science and Environmental Health Network.

Not surprisingly, the test uncovered dozens of toxic chemicals, including heavy metals, pesticides, and the chemicals used in industrial production that are present in everyday items. While certain lifestyle choices, like avoiding nonstick pans and eating organic food, have likely reduced my exposure to some compounds, there is still a disturbingly high level of toxins inside me. Even more unsettling, no one can say for sure how they got there, because it's impossible to link contaminants to a specific route of exposure. For example, although I avoided a toxic source like a vinyl raincoat, I may have been exposed to the same chemicals it contains and offgases—through the air, the water, or my food.

Here is an overview of some of the chemicals in my body, along with some of their most widely known sources:

Bisphenol A (BPA)—BPA is an endocrine disruptor, which means that it can interfere with the body's hormones. It causes a variety of health problems, particularly to the reproductive system. BPA is used in many everyday products from baby bottles to plastic water bottles to the linings of most canned food containers. When buying your refillable water bottle, make sure to check for the BPA-free label.

Lead—(see pages 73–74) a neurotoxin that was once widely used in gasoline and paint and is still used in many consumer products, from lipstick to electronics to children's toys.

Perflorinated compounds (PFCs)[b]—a probable cause of many cancers as well as liver and kidney damage, and reproductive problems, PFCs are used to make Stuff resist sticking and staining. They are found in microwavable popcorn bags, Teflon pans, and in some waterproof clothing and carpets.

Triclosan—linked to endocrinological problems, asthma, and allergies in animal studies. The Environmental Protection Agency (EPA) has listed triclosan as "could be" and "suspected to be" contaminated with dioxins.[c] Triclosan is used in many antibacterial products including soaps, cosmetics, household cleaners, and increasingly in a host of products advertised as "antibacterial," like socks, toys, and blankets, even though it isn't needed to fight disease causing microorganisms and may even be helping to develop stronger strains of those very organisms it seeks to destroy.

My body also carries organochlorine pesticides, some with names you may recognize **(DDT, Chlordane, Mirex)** alongside others that are less familiar (including **Hexachlorobenzene, beta-hexachlorocyclohexane, Oxychlordane, t-Nonachlor, Heptachlor epoxide**). They are neurotoxins and carcinogens and are associated with a range of chronic diseases. Many of the organochlorines were banned decades ago, yet they break down so slowly that they persist in the environment, our foodchain, and our bodies. My levels of these toxins were actually relatively low. When I asked Dr Schettler why, he guessed that I don't eat much meat—which is a primary route of exposure for fat-soluble pesticides. He was right. Starting at age fourteen, I didn't eat meat for twenty-four years. Today I occasionally eat chicken or fish but never red meat.

Mercury is devastating to the brain and nervous system (see pages 74–75). So it's bad news that the levels in my body are far higher than average; in fact I'm in the top 10 percent of people studied by the Center for Disease Control. After his many questions about potential exposure routes, Dr Schettler surmised that the mercury entered by body via my periodic tuna sushi splurges. Since receiving my test results I've renewed my commitment to avoiding eating large fish. Because our bodies eliminate mercury faster than more persistent pollutants, I should be able to lower these levels.

The highest-ranking chemical in my body is **Deca-BDE,** a flame retardant at the center of a major environmental health battle right now.[d] Lucky me. Super toxic, Deca-BDE is another probable carcinogen that damages the liver, kidney, and thyroid. My levels are as high as those of workers at those nasty electronics recycling facilities in developing countries, where toxic-laden electronics are destroyed by hand with little or no protective gear.

There's no way to know why my Deca levels are so high. One possible reason is that I live in California. California law—influenced by the powerful interests of flame-retardant producers—currently requires flame retardant use far beyond what is necessary for fire safety. This in turn motivates producers in other places to use excessive flame retardants so their products can be sold in California. Every state considering legislation that would ban Deca-BDE needs our support: even with mounting evidence of serious health impacts and the strength of alternative fire prevention approaches (like self extinguishing cigarettes), the industries producing Deca-BDE and other flame retardants are fighting hard to keep using them.[e]

My own body burden tests underscore one of the morals of the Story of Stuff: It's time for comprehensive, prevention-focused reform of how we use chemicals. As vigilant as we can be on the individual level, we'll never rid our bodies or the environment of toxins as long as we're still using them in our factories and our Stuff.

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[a] To learn more about body burden testing, or biomonitoring, see www.commonweal.org/programs/brc/index.html

[b] To learn more about perflorinated compounds, see www.pollutioninpeople.org/toxics/pfcs

[c] U.S. EPA. 1994. Estimating exposure to dioxin-like compounds, Vol. II: Properties, sources, occurrence and background exposures. Office of Research and Development. Review draft. Washington DC, June. pp. 3–54.

[d] To learn more about Deca-BDE, see cleanproduction.org/Flame.Scientific.php and environmentalhealthfund.org/documents/Deca%20Claims-Facts.pdf

[e] Environmental Health Fund, "Claims and Facts about Deca-PBE Flame Retardant," http://environmentalhealthfund.org/documents/Deca%20Claims-Facts.pdf

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Often it's cheaper for industries to use synthetics, but that's only because they rarely have to bear all the costs of making, using, cleaning up after, or disposing of these materials—in other words, the costs of paying for their ultimate ecological and health impacts. More externalized costs!

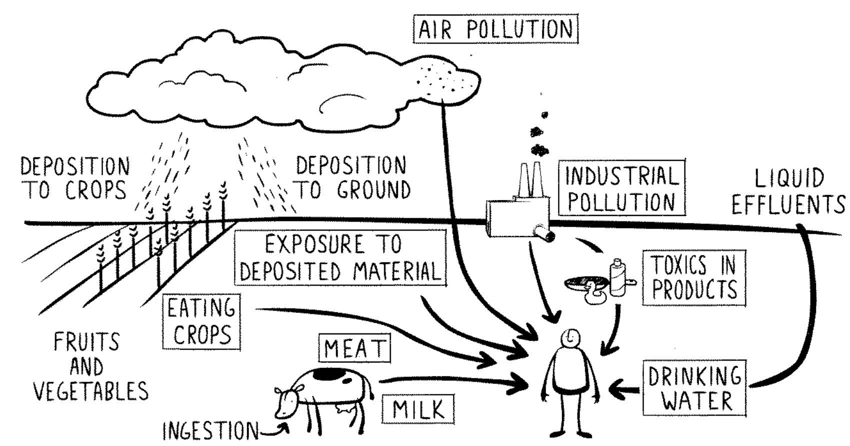
Only a handful of the tens of thousands of synthetic compounds in use have been screened for health and environmental impacts. Not one has been screened for full synergistic health impacts, which means the impacts on us when we're exposed to more than one of these compounds at the same time.[131] And these days, for those of us living in industrialized countries, that kind of multiple-compound exposure is pretty much constant.

The terrible truth is that once we make them (or, in the case of the heavy metals, extract and disperse them), it's very difficult, often impossible, to get rid of these materials. They travel vast distances, carried by wind and water and within animals. Many of them bioaccumulate or biopersist. We breathe tiny particles of them right into our lungs, drink them in with our water, absorb them from our Stuff. Our sunscreen, our furniture, our nonstick frying pans, our foam fire-retardant cushions, and our waterproofed fabrics, to name just a few sources, are all leaching toxins.

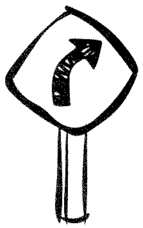
Toxics are everywhere now. Many scientific studies report they are ubiquitous. Scientists seeking an unexposed population tested native people in the Canadian Arctic, far from major industrial sources, and still found very high body burden levels of synthetic chemicals.[132] NGOs in the United States and Europe have vacuumed household dust, tested it, and found that it is full of toxic substances.[133] No wonder crawling babies and household pets often have such high body burden levels, even though they haven't been around long enough to come into contact with all the various sources of toxins or to be affected by what the chemical industry apologists call "lifestyle choices." In a study of umbilical cords, the Environmental Working Group found they contained an average of 287 agricultural and industrial chemicals each.[134] And, in a shocking violation of the sanctity of human life, breast milk, which is at the top of the food chain, now has alarmingly high levels of toxic contamination.[135]

The fundamental truth about all these dangerous materials is captured in one simple phrase: *toxics in, toxics out.* As long as we keep putting any of

EXPOSURE PATHWAYS OF TOXIC POLLUTANTS



these toxic ingredients into our production processes, toxics will continue coming out: in the products, and via pollution.



It seems like a lightbulb has gone off in the European Union, where in 2006 they passed the REACH act, which stands for Registration, Evaluation, Authorisation, and Restriction of Chemicals. Essentially, REACH means that companies have to prove that chemicals are safe before they get used and spread around,[140] as opposed to the "innocent until proven toxic" mentality that continues to reign in the United States. That mentality is illustrated by our ancient and notoriously weak Toxic Substances Control Act (TSCA), which has not been updated since its adoption in 1976. At its adoption, TSCA allowed 62,000 chemicals in use to continue without testing them; it has since allowed another 20,000-some chemicals to enter the market, resulting in tens of thousands in wide use today despite growing evidence of serious health risks.[141] To begin to rectify the situation, lawmakers introduced the Kid-Safe Chemicals Act (KSCA)

INTO THE MOUTHS OF BABES

Toxics in breast milk? Talk about a controversial issue.

This is a hard one to talk about for many reasons. It is the last thing that a new mother wants to think about while holding that precious little bundle of joy. It is scary. It feels overwhelming. It may discourage mothers from breast-feeding, which is still, by far, the best food for babies.

But we've got to talk about it. Silence only serves the polluters who, I am sure, would be grateful if no one ever brought up the issue of toxics showing up in human breast milk. So let's talk about it. Let's talk about it often, and loudly.

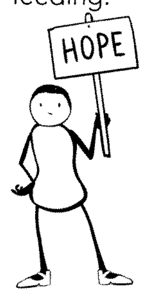
As I've said, every person alive today carries in his or her body a diverse range of toxic chemicals, thanks mostly to modern industrial processes and products. Pregnant and nursing women, and developing fetuses and newborn children—the littlest, most vulnerable members of society, with their rapidly growing brains and bodies—are no exception.

There have been a number of studies by medical professionals, government health agencies, environmental health groups, and others to track pollutants in breast milk. The Environmental Workgroup Group (EWG), for example, tested for toxic flame retardants in milk from twenty first-time mothers across the United States.[136] These flame retardants are linked to neurological problems, including reduced learning, attention, and memory. EWG's results showed some of the highest levels of flame retardants in breast milk ever

found globally, with average levels seventy-five times higher than averages found in Europe, where some of these flame retardants have been banned.[137]

In the face of all the anguish and fear that this news brings with it, there are some important things to remember:

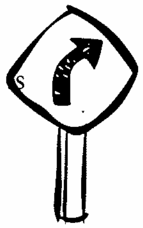
- The problem is not the mother, but the broader industrial system. We wouldn't have toxics in our breast milk if we hadn't developed an industrial model that permeates our communities with toxins, overseen by a regulatory model that really has no clue what's going on with these chemicals.
- Breast is still best. Breast-feeding provides nutrients, minerals, antibodies, and powerful emotional bonding for new babies. It helps mothers recover from pregnancy, and mothers who breast-feed have lower rates of ovarian and breast cancer later in life. (Breast-fed daughters may also have lower rates of breast cancer.[138]) Even in light of the scary news about toxics, environmental health and medical experts continue to recommend breast-feeding.



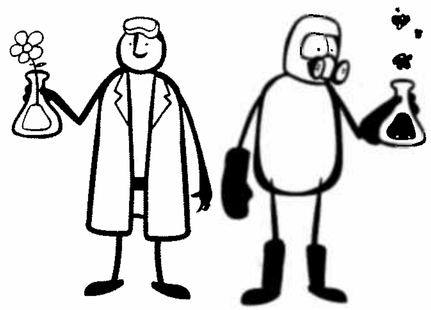
The problem is not irreversible. Long-term testing of breast milk has shown that once toxic chemicals are removed from use, their levels in breast milk decline. The data comparing U.S. levels to those in Europe, where some flame retardants have been banned since 2004, proves there's lower contamination in places where the use of chemicals has been effectively restricted.[139]

in May 2008. KSCA takes Europe's REACH approach, placing the burden of proof on chemical companies to demonstrate that chemicals are safe *before* being introduced into commercial use.[142]

"When babies come into this world pre-polluted with hundreds of dangerous industrial chemicals already in their blood, it's clear that the regulatory system is broken," says Ken Cook, president of the Environmental Working Group. "The Kid-Safe Chemicals Act will change a lax, outdated system that presumes chemicals are safe into one that requires makers of toxic chemicals to prove their safety before they're allowed on the market. This bill is a long-overdue move to put public health ahead of chemical industry profits."[143] The chemical industry is rallying its troops of public relations specialists and lobbyists to defeat KSCA, so to get on board and help turn this bill into law, contact the Safer Chemicals, Healthy Families Campaign, working in Washington, D.C., and in communities across the country to pass laws to reform industry practices with regard to chemicals. Visit www.saferchemicals.org and saferstates.org to learn more.



Rather than focus on reducing any one population's (like children's) exposure to hazardous chemicals, the simplest solution to phase out toxics altogether and replace them with safe materials. This approach is far more effective, since the level of hazard in a chemical is controllable, while exposure is not, especially with chemicals that persist, disperse, and build up throughout ecosystems. This is where green chemistry comes in. Pioneering green chemists are designing new materials from the molecular level up to satisfy all our requirements (for things to be sticky, strong, colorful, flame-resistant, etc.) while also being fully compatible with ecological and human health. To learn more about green chemistry, visit Clean Production Action at www.cleanproduction.org.



The Front Lines

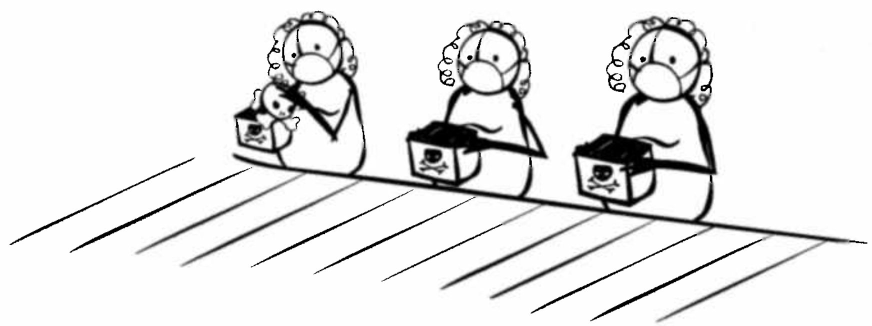
Up to now I've mostly been talking about how consumers like me are exposed to toxins through Stuff in stores and in daily life. But consumers are actually the third and last group of people to be affected by the toxins used in production processes. First come the workers actually making and assembling our Stuff.

The lyrics to one of my favorite songs, *More Than a Paycheck,* by the a cappella group Sweet Honey in the Rock, go like this: "We bring more than a paycheck to our loved ones and families . . . I bring home asbestosis, silicosis, brown lung, black lung disease, and radiation that hits the children before they've really been conceived." [144] It's true. Workers are on the front line, routinely exposed to toxic chemicals by touching them, inhaling them, and sometimes carrying them home on their clothing to share with their families. They bear the heaviest, unfiltered brunt of exposure to toxic inputs and dangerous processes and products. As Dr. Peter Orris, chief of environmental and occupational medicine at the University of Illinois Medical Center, laments, "These diseases and deaths are completely preventable. Civilized society should not tolerate this unnecessary loss of life either on the job or in our communities." [145]

The National Institute for Occupational Health and Safety (NIOSH) is the government entity focused on safety and health in the workplace. NIOSH believes that millions of workers in the United States are routinely exposed to substances found to be carcinogenic in animal studies and that millions more may be exposed to yet-undetermined carcinogens, since more than 98 percent—nearly all—of the substances used in our factories today have not yet been tested for carcinogenicity.[146] NIOSH estimates that work exposure to carcinogens causes about twenty thousand cancer deaths and forty thousand new cases of cancer each year.[147] And cancer is only one of a number of diseases linked to exposure of toxic substances at work; there's also cardiovascular disease, reproductive and neurological disorders, skin problems, respiratory diseases including asthma, and more. Maybe Sweet Honey should rewrite their song: "I bring home more than a paycheck to my loved ones and family, but I can't tell you what else I bring home since no one has bothered to study these chemicals that I inhale and handle all day at work."

But at least in the United States today there's growing awareness of the risks that workers face and increased safety regulations in the workplace. Back when environmental health activists first started raising concerns about industrial chemicals, many companies brushed aside concerns and focused their employees' attention on how environmentalists threatened to close factories and risk jobs. Corporate managers often framed the issues as "jobs versus environment." For a while this served to divide the two groups—representatives of labor versus environmental defenders. Ultimately it became clear that a healthy environment and good jobs that protect workers' health are integrally connected and mutually dependent.

In large part this shift in understanding came about through the work of one of my heroes, the late great Tony Mazzochi, a labor leader with the Oil, Chemical and Atomic Workers Union, who is frequently referred to as the



Rachel Carson of the labor movement. Throughout the 1960s Mazzochi informed workers about toxic threats, exposed information about workplace dangers to the public and policymakers, and, very important, built alliances between labor and environmentalists, defeating the attempts to keep these two powerful constituencies isolated. Today's movement for green jobs—dignified employment that is good for workers and for the planet—owes a debt to Mazzochi's tireless efforts.

We still have a ways to go in the United States before our factories are entirely green and toxics free, but meanwhile one of the tragic side effects of our cleaning things up at home has been exporting the nastiest production processes to poor countries around the world. I've seen many a dismal factory on nearly every continent, but my most gut-wrenching experience was in Gujarat, India, a region the Indian government calls the "golden corridor" because of the influx of international investment dollars. In my circles it's known as the "cancer corridor," because it's full of life-threatening chemical production plants, some of which were relocated from Western countries with stricter standards.

In 1995 my friends and I took the train from vibrant Delhi to the hot, dry, and dusty town of Ankleshwar, which is just one of about two hundred "industrial estates" in the Gujarat region. There, hundreds of factories crowded the area as far as the eye could see, sharing the same roads, power plants, and, as an afterthought, the same inadequate waste disposal sites. The air was thick with a stinky toxic stew from the plastics, petrochemicals, pesticides, and pharmaceuticals being manufactured. And in every free space between the factories, workers had built makeshift homes out of scraps of metal and wood. I tried not to think the about how these homes would fare during the annual monsoons.

Running right alongside the shacks and the roads were small ditches filled with foul-smelling reddish-brown liquid waste. From the look and smell of it alone we could tell this gunk was toxic—and my colleagues' tests would reveal that the wastewater contained mercury, lead, and many other chemicals that cause reproductive disorders and liver, brain, and kidney damage. Life went on around these ditches with no precautions—I watched barefoot children leap back and forth over them as they played, and women in bright saris squatted and cooked nearby. I followed the ditches to where they ended in a gigantic holding pond. There the young man who managed the pond's pump emerged from a utility shed to greet us, proud to explain his work to a group of curious foreigners.

What we learned was that he actually lived with the pump. Night and day without a break, he monitored the level of liquid in the holding pond.

When it neared capacity, his job was to turn on the pump. This drained some of the waste liquid out of the pond, from where it was transported by more open-air ditches to a local river, then to the sacred Narmada River, and eventually to the Gulf of Cambay (now known as the Gulf of Khambhat) where the local fishermen fished. Everything—the pump operator's T-shirt, his thin cotton sleeping mat, and the walls of the tiny five-foot by six-foot space in which he coexisted with the deafening pump machinery—was splattered with the gunk. A dark flood mark lined the walls: the place had been flooded knee-deep with the waste at least once.

Then, in front of my very eyes, he turned on the pump and, finding it wasn't running smoothly, he casually reached his bare arm up into the hose and pulled out a fistful of twigs and other debris drenched in the toxic liquid. The pump sputtered and started working. As he smiled, pleased with his successful repair, my friends and I were hit by the sickening realization that the problem went way beyond toxic waste and pollution: this was also clearly a human rights violation, a health threat, a tragedy of poverty, and an outrageous injustice. It was a scene no consumer ever imagines when he or she takes a product off the shelf in a Wal-Mart or Target thousands of miles away.

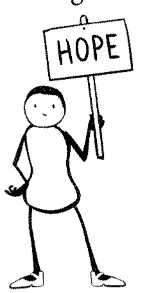
Fence-line Communities

In addition to the people who buy Stuff (consumers) and those who make Stuff (workers), there is one more group of people deeply affected by production processes: the people who live, work, and play near factories. These communities, whose children grow up in the shadows of giant factory smokestacks, are often called host communities or fence-line communities. They are virtually never consulted or informed when faraway CEOs make decisions about how and where dirty facilities will be operated. Rampant rates of cancers, birth defects, respiratory diseases like asthma, lowered attention and IQ, and radically shortened life spans plague these communities, no matter where in the world they are. And there's something else these communities have in common: they are usually poor, and the people in them are usually not white skinned.

This phenomenon is known as environmental racism—that is, the placement of the most toxic facilities in communities of color, zoning and other practices or policies that result in disproportionate burdens being placed on communities of color, and the exclusion of people from these communities from environmental planning and decision making. In the 1980s, the environmental justice (EJ) movement emerged in the United States in response to these fundamentally unfair practices and offered an alternative vision—one of environmental health, economic equity, and rights and justice for all people.[148]

In 1987, the budding EJ movement was bolstered by the first study to solidly document that the racial composition of a community was the most significant factor in determining whether or not a toxic waste facility was likely to be located nearby: *Toxic Wastes and Race in the United States,* published by the United Church of Christ (UCC). This astounding report showed that three out of every five African Americans and Hispanic Americans lived in communities with uncontrolled toxic waste sites.[149]

I remember when UCC released the findings, during my first year working at Greenpeace in its Washington, D.C., offices. The report sent shock waves through traditional environmental organizations, most of which didn't have industrial environments and racial justice on their radar screens. It was impossible to deny that the bulk of the issues that major environmental groups addressed—whales, forests, baby seals—utterly ignored the thousands of people living in the shadows of gigantic polluting industrial facilities and dumpsites. Sadly, some traditional environmental groups chose to downplay the report or to respond defensively. For others, the findings inspired some serious self-reflection. Some groups woke up to the fact that their boards, their staff, and their members were largely white, which meant they'd left a large segment of the U.S. population out of their strategic discussions and efforts. That is a pretty big oversight.



The UCC report helped inspire a powerful, diverse movement that saw environmental sustainability and social justice issues as inseparable. As civil rights and environmental justice activist Cora Tucker said, "People don't get all the connections [when] they say the environmental is over there, the civil rights group is over there, the women's group is over there and the other groups are here. Actually, all of them are one group, and the issues we fight become null and void if we have no clean water to drink, no clean air to breathe and nothing to eat."[150]

With the movement gaining momentum globally, the first ever National People of Color Environmental Leadership Summit was held in Washington, D.C., in 1991. Soon after, in 1993 President Clinton signed an executive order that created the National Environmental Justice Advisory Council to the EPA.[151] So by then, there was solid evidence of a racial bias in the choice of locations for polluting and hazardous facilities; there was a growing broad-based movement for environmental justice; and there was a presidential executive order and a special advisory council to the national Environmental Protection Agency. But while all that ought to have solved

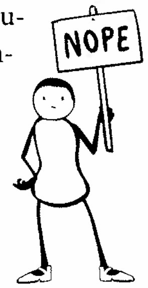
environmental racism, at least in the United States, that's not what happened.

Twenty years after the release of the first report, the UCC released *Toxic Wastes and Race at Twenty, 1987–2007,* which found the problems persisting and, in some areas, growing worse. "Race continues to be an independent predictor of where hazardous wastes are located, and it is a stronger predictor than income, education and other socioeconomic indicators. People of color now comprise a majority in neighborhoods with commercial hazardous waste facilities."[152] As Steve Lerner, an author and research director at the environmental health institute Commonweal, writes, "More remains to be done to keep America from being divided into livable communities, where the environment is relatively clean; and "sacrifice zones," where residents are exposed to the toxic by-products of a production process that keep goods artificially cheap and corporate profits rising. Many Americans do not realize [this is] part of the reason they are able to buy goods so cheaply."[153]

The fact that twenty years later, environmental racism persists and, in fact, has increased is shameful for all of us. This cannot continue. Of course, the answer to environmental racism is not some sort of "equitable pollution" in which we all share the toxic burden equally; the answer is to clean up our production processes and environmental governance so that no one—regardless of age or race or income, regardless of whether they are living now or in generations to come—has to subsidize the creation of Stuff chock-full of chemicals with his or her health and well-being.

We need to demand strong environmental health laws for everyone and the elimination of double standards in which whiter or richer communities get preferred treatment. And when I say for everyone, I don't just mean Americans. One of globalization's worst trends has been wealthy (often predominantly white) nations exporting the filthiest, most poisonous factories and facilities to countries that have weaker environmental, health, and worker protection laws; less capacity to monitor and enforce those standards that do exist; and, very important, less public access to information and involvement in the decision process. Hazardous industries follow the path of least resistance; they go to those places perceived as lacking the political, economic, educational, or other resources to resist them. Metals smelting, electronics production, PVC production: all these industries are increasingly being shut down in the United States while the number of facilities is expanding in developing nations. We're happy to take the products; we just don't want the mess. That's what is happening. And that is not okay.

If a particular industrial process is too toxic for U.S. communities, for American children, then it is too toxic for any community, for every child. Motivated both by a sense of global responsibility and justice, as well as by growing evidence that exported pollution still comes back to haunt us via air currents, food, and products, a growing number of communities are moving beyond NIMBY (not in my back yard) to NOPE: not on planet Earth. I'm right there with them.



Union Carbide on the Other Side of the Fence

From the massive chemical facilities in New Orleans to the diesel-exhaust-filled neighborhoods of the Bronx to the slums of Port-au-Prince to the belching refineries of Durban, I've seen for myself how communities that are poor, illiterate, and nonwhite are treated as expendable. But probably nowhere on earth is it more dramatically in evidence than in Bhopal, India. Bhopal, the City of Lakes and the City of Mosques, is best known today as the site of the world's largest chemical industrial disaster ever. What a claim to fame.

Late on the night of December 3, 1984, the poisonous gas methyl isocyanate (MIC) leaked from a factory owned by the U.S. multinational Union Carbide Corporation. The gas killed more than eight thousand people immediately, with a death toll now at twenty thousand and still counting, as people continue to succumb to related health impacts, averaging one more death each day over the last two decades.[154]

The stories I heard from survivors about "that night" haunt me: People woke in the darkness to the sound of screams, with the invisible gas burning their eyes, noses, and mouths. At first some thought a neighbor was burning too many chili peppers. Others thought the day of reckoning had arrived. Many began vomiting and coughing up froth streaked with blood. Not knowing where the gas was coming from, they just ran. Whole neighborhoods fled in panic, families were separated, many who fell were trampled, and others convulsed and fell dead. Within hours, thousands of dead bodies lay in the streets. Many people never found their missing family members and could only assume the bodies were among those hastily thrown into mass graves.

Some accounts call what happened that night an accident, but I call it an inevitability. Cost-cutting measures and overall sloppy management at the plant led to reduced staff safety training, ignored warnings about dangerous chemical storage practices, and no community warning mechanism. That night, not one of the six safety systems designed specifically to protect

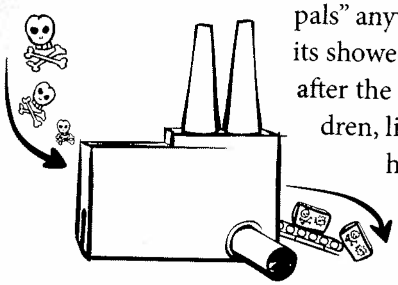
against a gas leak like this was functioning. Not one! You can't have a factory storing huge amounts of toxic chemicals and expect nothing bad to happen, especially if you run the place like you just don't care.

The factory was located in a densely populated part of the city, with small huts jam-packed full of sleeping families just meters from the factory walls. When the gas began leaking from the facility, Union Carbide staff did not notify police or warn community residents; in fact, they denied being the source of the leak for those first critical hours, during which the community members frantically ran to escape the suffocating gas and authorities scrambled to understand what was happening. Many believe that had the company admitted the leak and shared basic information, such as the importance of covering one's face with a wet cloth, many deaths could have been avoided.

Unbelievably, today, twenty-five years after the disaster, the company still refuses to share its information on the toxic health impacts of MIC, calling it a "trade secret," thwarting efforts to provide medical care to victims of exposure.[155] To add insult to injury, the abandoned Union Carbide factory, now owned by Dow Chemical, still sits there, leaking hazardous chemicals and waste left behind in the aftermath of the disaster. On the gates local residents have painted skulls and crossbones with dollar signs for eyes and have scrawled "killer Carbide" and "The Real Face of Globalization." Soil and water samples from around the plant, tested by Greenpeace fifteen years after the disaster, were full of heavy metals and other toxins.[156] A February 2002 study found mercury, lead, and organochlorines in the breast milk of the local women.[157] The children of gas-affected women are subject to a frightening array of debilitating illnesses, including retardation, gruesome birth defects, and reproductive disorders.[158]

Even having read a lot about that night, as soon as I arrived in Bhopal in 1992 for the first of many visits, I realized I'd underestimated the depth of the horror that occurred there. And I definitely was not expecting the many rays of strength and hope that abound among the survivors. They don't call themselves victims, because they aren't just sitting there taking it—they're fighting back. In fact, a Bhopali friend, Satinath Sarangi, and I call the city the "Fight Back Capital of the World." Two survivors, Champa Devi Shukla and Rashida Bee, were awarded the prestigious Goldman Environmental Prize for outstanding courage and tenacity in the struggle for justice in Bhopal. In the award acceptance speech, Bee said proudly, "We are not expendable. We are not flowers offered at the altar of profit and power. We are dancing flames committed to conquering darkness and to challenging those who threaten the planet and the magic and mystery of life."[159]

Each year, on the anniversary of the disaster, the survivors hold a commemorative protest. I was there again in 1994 for the tenth anniversary of the disaster. Poets sang *ghazals* about the loss of loved ones and the fight for justice. Colorful banners demanded justice and called for "No More Bhopals" anywhere on earth. Heart-wrenching photo exhibits showed large black and white images of the morning after the disaster, with dead bodies, many of them children, lining the streets awaiting identification. I saw a haunting photo of a small girl being buried, her father wiping away the soil from her face for one last look. As a parent myself, it is almost unbearable to look at that picture and allow myself to feel what that must have been like. I know that as long as we continue to rely on the toxins in, toxins out model of production, disasters like this one are inevitable.



The culmination of the anniversary events each year is the construction of a giant papier-mâché effigy of Warren Anderson, the CEO of Union Carbide at the time of the disaster. Survivors demand that Anderson come to Bhopal and face charges for his role in the management decisions that lead to the disaster. The Indian courts have a warrant out for his arrest, which he ignores from his comfortable home in Connecticut. The year I was there, the two-story-tall effigy of Anderson resembled a villain from an old movie, in a grey suit and hat, with a sinister mustache. When evening came, thousands of people took to the streets, chanting, yelling, and marching to the gates of the Carbide factory, where they lit the effigy on fire. Disoriented by the masses of shouting people and watching huge chunks of the burning effigy break off and float over the crowded, highly combustible slum, I began to imagine what it must have been like that night in the dark and chaos and fear.

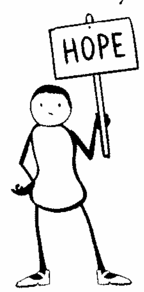
Meanwhile all year long, every year since the disaster, the local community and allies globally in the International Campaign for Justice in Bhopal work to provide health care to the gas-affected and to fight for justice in Bhopal. The survivors' demands include: a cleanup of the abandoned, leaking factory; the provision of clean drinking water, since theirs has been contaminated; long-term health care and economic and social support for those who lost family members or are unable to work due to gas-related illnesses; and justice for those responsible for the shoddy factory maintenance.[160]

Elsewhere, news of the Bhopal disaster made headlines internationally and got a lot of people worried, from corporate executives of other chemical companies to residents of communities living near chemicals plants.

Union Carbide had a factory in Institute, West Virginia, which it had previously said was nearly identical to the Bhopal plant.[161] After the Bhopal disaster, workers and residents in Institute and other chemical-industrial communities began asking questions. Which toxic chemicals was the local factory using? Were toxic emissions coming from the plant, and if so, how much? Was a Bhopal-like disaster possible elsewhere?

Then in 1985, U.S. representative Henry Waxman, chairman of the House Health and Environment Subcommittee, released an internal Union Carbide memo that stated that a "runaway reaction could cause a catastrophic failure of the storage tanks holding the poisonous [MIC] gas" at the West Virginia plant.[162] The EPA confirmed that the Institute plant had experienced twenty-eight smaller gas leaks between 1980 and 1984.[163] Understandably, people freaked out.

The Chemical Manufacturers Association (CMA), now called the American Chemistry Council, responded with something they called the Responsible Care program and announced that its members were committed to a global voluntary safety program that would be self-audited and would "continuously improve their health, safety and environmental performance."[164] Based on this, CMA argued that more stringent regulations of their facilities weren't needed. As one NGO working to increase public access to information put it, the program basically had zero measurable goals, timelines, or external validation for reducing chemical hazards and essentially said to the public: "Trust us, don't track us."[165]



The U.S. government's response, by contrast, was surprisingly useful. In order to help residents find out what chemicals are being used and released into their communities, the feds established the Toxics Release Inventory (TRI), which is a database of information about toxic chemicals releases, both via air and in waste. The TRI was created as part of the Emergency Planning and Community Right-to-Know Act of 1986.[166] This law requires companies to report the amount and location of toxic chemicals they use in order to assist emergency workers in the case of an accident. In addition, the law requires that companies producing or using toxic chemicals above specific threshold amounts provide data on toxic chemicals released via the air or in waste. Currently about 22,000 industrial and federal facilities are covered in the TRI. In 2007, those facilities reported that 4.1 billion pounds of 650 different toxic chemicals were released into the environment, including both on-site and off-site disposal.[167]

The data compiled in the TRI is available to the public through both government and nongovernmental websites. My personal favorite is Scorecard (www.scorecard.org), which allows you to look up major pollution sources and chemicals by zip code. Scorecard provides information on health impacts, factory profiles, and even lets viewers send a message to their local polluters via the website.

I regularly check Scorecard to see how my own town is doing on the toxics front. It is a sobering experience. Berkeley is a city that prides itself on its high level of environmental awareness. Our public schools serve organic food. There are free parking places downtown for fully electric cars. Yet, my county ranks among the dirtiest 20 percent of all counties in the United States![168] The top polluters in my zip code include manufacturers of machinery and plastics as well as the stinky steel refinery just down the road from my house. The top twenty pollutants reported for my area are glycol ethers, xylene, n-butyl alcohol, toluene, 1,2,4-trimethylbenzene, methanol, ammonia, methyl isobutyl ketone, ethylene glycol, methyl ethyl ketone, styrene, barium compounds, m-xylene, N,N-dimethylformamide, lead, zinc compounds, ethylbenzene, cumene, n-hexane, and formaldehyde.[169] Yuck.

The TRI is a great source of information on local pollution sources and on trends in different industrial sectors, but it still needs to be stronger. Scorecard describes TRI's five biggest limitations: (1) it relies on self-reporting by the polluters, rather than actual monitoring; (2) it doesn't cover all toxic chemicals; (3) it omits some major pollution sources; (4) it does not require the companies to report the amount of toxic chemicals used in products; and (5) it does not provide information about the possible exposures people may experience as a result of the releases.[170] Once these shortcomings are addressed, the TRI could be an even more powerful tool for the public, one we can use to pressure companies to find alternatives to the toxic chemicals they use.

Watching Out for Us (Or Not)

Maybe the TRI has you contemplating the role of the government in all this. Haven't we elected or appointed someone to be in charge of making sure that we're safe from dangerous chemicals? What about the Food and Drug Administration? The Environmental Protection Agency? The Occupational Safety and Health Administration? Well, the very sad and very scary fact is, our government's regulation of toxic materials is riddled with holes.

For starters, the government's regulation takes a fragmented approach. We regulate chemicals in consumer products, air, water, land, our food, and our factories separately. A fundamental problem with this division of roles

is that it approaches the environment as if it were a collection of discrete units, rather than one complex interrelated system. Often the agency staff who regulate the same chemical compound in water, air, our products. and the workplace don't even talk to one another, and when they do, they sometimes vehemently disagree.

Take fish, for example: the EPA has authority to monitor pollution in fish you catch from a stream, while the FDA has authority over a fish that someone else catches and you buy at the grocery store. The two agencies are supposed to work together and sometimes they do, like in 2004, when they jointly released guidelines recommending that pregnant women, women of childbearing age, nursing mothers, and young children not eat more than 12 ounces of fish each week in order to limit mercury intake.[171] Then, in late 2008, the FDA drafted a new report recommending that women now eat *more* than 12 ounces of fish each week.[172] The *Washington Post* reported that the FDA did not consult the EPA until the report was nearly completed. EPA internal memos called the new FDA recommendations "scientifically flawed and inadequate" and said that they fell short of the "scientific rigor routinely demonstrated by EPA."[173] The watchdog organization Environmental Working Group went even further, declaring the FDA's report "an astonishing, irresponsible document. It's a commentary on how low FDA has sunk as an agency. It was once a fierce protector of America's health, and now it's nothing more than a patsy for polluters."[174]

If these two agencies can't get on the same page about something as critical and basic as keeping neurotoxins off our dinner plate, what can we expect of the whole mess of government measures? Just take a look at the various agencies, commissions, and laws we're relying on:

GOVERNMENT LAWS & AGENCIES

Executive Branch

National Environmental Policy Act (NEPA) (1969)
A broad national framework to assure that all branches of government give proper consideration to the environment.

Council on Environmental Quality (CEQ) (1969)
Within NEPA, ensures that environmental amenities, services, and values are considered in decision making. Administered by the Office of Environmental Quality.

Food and Drug Administration (FDA) (mandated by the Federal Food, Drug and Cosmetic Act 1938)
Within the Department of Health and Human Services, the FDA is responsible for protecting the public health by assuring the safety and efficacy of our nation's food supply, medicines, cosmetics, etc. Amended in 2002 to authorize the EPA to set maximum limits for pesticide residues on foods.

Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) (1970)
Created within the Department of Labor by the Occupational Safety and Health Act (1970) to assure safe and healthful conditions for workers. OSHA handles enforcement while NIOSH (now part of the Department of Health and Human Services' Centers for Disease Control and Prevention) conducts research, education, and training on occupational hazards.

National Oceanic and Atmospheric Administration (NOAA) (1970)
Within the Department of Commerce, a science-based agency responsible for predicting changes in the oceanic and atmospheric environments and living marine resources. NOAA encompasses the **National Environmental Satellite, Data and Information Service, the National Marine Fisheries Service** (responsible for the management, conservation, and protection of living marine resources), the **National Ocean Service** (maintains safe, healthy, and productive oceans and coasts, for example by ensuring safe and efficient marine transportation), the **National Weather Service,** and the **Office of Oceanic and Atmospheric Research** (provides research for NOAA).

Consumer Product Safety Commission (CPSC) (created by the Consumer Product Safety Act, 1972)
Protects the public from risks associated with consumer products such as electrical, chemical, or mechanical hazards.

Consumer Product Safety Improvement Act (2008)
Establishes consumer product safety standards and other safety requirements for children's products (modernizes the original act).

Environmental Protection Agency (EPA) (1970)
EPA's mission is to protect human health and to safeguard the natural environment—air, water, and land—upon which life depends. EPA coordinates research, monitoring, standard-setting, and enforcement activities to ensure environmental protection.

Laws Administered within the EPA

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (1947)
Registers (licenses), or exempts from registration, the sale and use of pesticides, including antimicrobials, for control of pests that threaten crops, animals, and humans.

Food Quality Protection Act (1996)
Sets safety standards on pesticide tolerances, especially for infants and children.

Toxic Substances Control Act (TSCA) (1976)
Addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon, and lead-based paint.

Clean Air Act (CAA) (1963, extended 1970, amended 1977 & 1990)
Limits certain air pollutants, including from sources like chemical plants, utilities, and steel mills. Individual states or tribes may have stronger air pollution laws, but they may not have weaker pollution limits than the federal standard. The 1990 revisions address emissions trading and clean fuel standards.

Clean Water Act (CWA) (1972)
Regulates discharges of pollutants into the waters of the United States and regulates quality standards for surface water.

Safe Drinking Water Act (1974, amended 1986, 1996)
Protects the quality of all waters actually or potentially used for drinking, from both above-ground and underground sources, and requires public water systems to comply with these primary (health-related) standards.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (aka Superfund, 1980)
Provides a special fund (originally $1.6 million) for cleaning up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Seeks out parties responsible for any releases and assures their cooperation in the cleanup.

Superfund Amendments and Reauthorization Act (1986)
Updates CERCLA to increase states' involvement and citizen participation, increase the focus on human health impacts, revise the Hazard Ranking System, and increase the size of the trust fund to $8.5 billion.

Emergency Planning and Community Right-to-Know Act (1986)
Designed to help local communities protect public health, safety, and the environment from chemical hazards. The Community Right-to-Know provisions increase the public's access to information on chemicals at individual facilities, their uses, and releases into the environment.

Oil Pollution Act (1990)
Provides resources and funds to clean up oil spills as well as mitigation requirements for the polluter.

Resource Conservation and Recovery Act (RCRA) (1976, 1986, plus 1984's Hazardous and Solid Wastes Amendments)
Gives EPA the authority to control hazardous waste from "cradle to grave," including generation, transportation, treatment, storage, and disposal. Amendments focus on waste minimization and more stringent standards for hazardous wastes.

Pollution Prevention Act (1990)
Focuses on reduction of industrial pollution at the source, alongside resource efficiency and conservation, as part of pollution prevention.

Endangered Species Act (ESA) (1973)
Protects threatened and endangered plants and animals and their habitats.

Marine Protection, Research, and Sanctuaries Act (aka Ocean Dumping Act, 1972)
Prohibits ocean dumping.[175]

Notice something that all these have in common? Many were created before any of us had cell phones or Internet access; some were established even before fax machines. Lots were created before Rachel Carson's *Silent Spring*, before the Bhopal disaster, before climate change was a household topic. While the intentions at their founding were good, many of these

agencies and laws are now simply out of date. Even the more recent amendments are often out of date. Environmental health threats have changed and continue changing while our understanding of those threats has evolved greatly, but the laws and regulatory agencies haven't kept up. Many of these laws were made back when people still believed that "dilution is the solution to pollution." Back then, folks thought that taller smokestacks or longer discharge pipes would solve the problem. No longer.

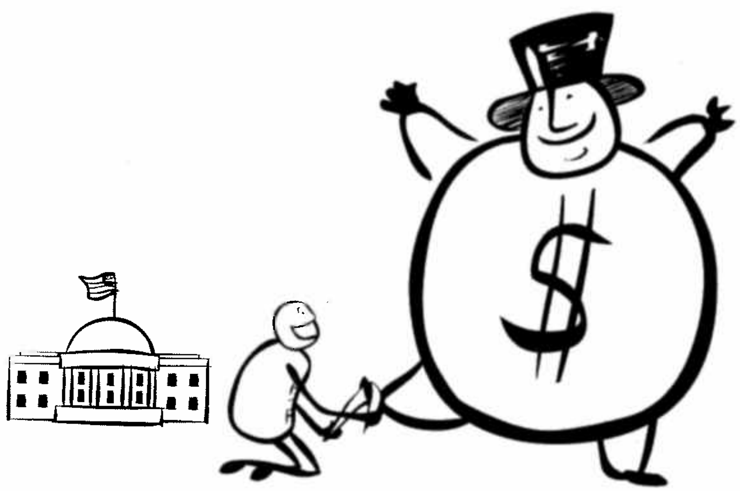
To further confuse matters, implementing the federal regulations set by many of these agencies is often a state-level responsibility. That means that compliance and enforcement varies from state to state depending on the priorities and powerful interests within each state. "States dominated by specific industry types (chemicals, mining, specific types of manufacturing) tend to be more tolerant of noncompliance by those sectors than other states with more heterogeneous industrial mixes," writes Professor Ken Geiser of the University of Massachusetts Lowell.[176] And since laws are only as strong as compliance and enforcement, this means that the effectiveness of these laws can look very different in different places.

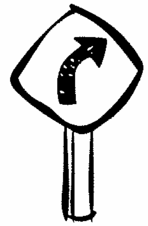
Another huge issue is that so-called independent advisory committees that provide policy recommendations or scientific advice to government are stacked with people who have financial interests in the very activities on which they are advising. Isn't that what people mean when they say "the fox is guarding the henhouse"? In the United States there are about nine hundred advisory committees that provide peer review of scientific research, develop policy recommendations, evaluate grant proposals, and serve other functions to support good governance.[177] These committees are so active in providing advice to Congress, federal agencies, and the president that they are sometimes referred to as the "fifth arm of government."

Federal law requires that these independent committees have members who represent a balanced diversity of views and who are free from conflicts of interest (that is the "independent" part). In spite of that mandate, however, industry influence continues to dominate these committees, undermining their value and credibility as sources of independent and unbiased expertise. For example, in 2008, the FDA released a report that found that bisphenol A (BPA), a plasticizer used in food packaging and many water bottles, is safe.[178] This report followed growing concern about BPA's links to neurological, developmental, and reproductive harm to children. Then the Integrity in Science Project reported that the two main studies on which the FDA based its analysis were funded by a unit of the American Chemistry Council, an industry trade group that includes companies that produce or use BPA.[179] This is just one example from a long list of suspect information sources and appointments among government advisory committees. (And there's still no federal ban on BPA, despite proof that it causes reproductive damage in animals. To help get BPA out of food packaging, visit www.saferstates.com/2009/06/safer-cans.html.)

The nonprofit Center for Science in the Public Interest (CSPI) is one organization that researches and campaigns against corporate influence on science-based public policy. CSPI scrutinizes more than two hundred science-based federal advisory committees for undisclosed conflicts of interest and posts the results in a searchable online database (www.cspinet.org/integrity). In early 2009, CSPI released a new report, *Twisted Advice: Federal Advisory Committees Are Broken*, which revealed that government advisory panels continue to be skewed toward industry, largely through an overrepresentation of industry members with direct financial interest in the outcome of the committees' work.[180]

It's clear that the current approach to regulating toxic chemicals, worker safety, and broader environmental issues is not functioning to protect us. In some cases—like the chemical industries stuffing advisory panels with their people—the intent is bad. In other cases—like the mix-and-match collection of laws and agencies with overlapping areas of jurisdiction—the structure is bad. In either case, we clearly need another way. We need regulators and scientists who are working for the well-being of people, not for specific industries. And we need laws and agencies that understand and reflect the complexity of the planet, including the natural environment, the built environment, communities, workers, kids, mothers—the whole package.





Professor Ken Geiser, who is also the director of the Lowell Center for Sustainable Production, laid out a vision for a different approach in his 2008 paper *Comprehensive Chemicals Policies for the Future*. According to Geiser, a new chemicals policy would consider chemicals as components of the broader system of production in which they are used, not as isolated individual entities, which is never how they actually show up. A more successful approach to chemicals policy would include researching and disseminating more complete information on whole classes of chemicals, ramping up development of less toxic alternatives, and converting industry sector by sector from using high-hazard chemicals to using ones that represent a low hazard. With an integrated systems perspective, it will be possible to transform electronics, transportation, health care, and other sectors away from a reliance on toxic chemicals. As Geiser notes, "We need to think less about restriction and more about conversion."[181]

It Wasn't Always This Way

The problems with the production of Stuff seem nearly intractable. If you were born anytime in the last sixty-odd years, it's hard to imagine that things could possibly be any different. But it wasn't always like this. The most toxic parts of today's production processes have been with us for less than a hundred years. And that is cause for hope.

For a long time, the production of all our Stuff caused far less environmental harm. There were definitely some negative health impacts in early production, especially around the use of heavy metals like mercury and lead before people realized they were as dangerous as they are. But it was insignificant compared to today's global environmental destruction and persistent toxics, their reach extending from seemingly pristine wilderness areas to the fat cells of every person on the planet.

When we look back through history, we see two periods of change that fundamentally transformed production processes, with devastating effects. Before the Industrial Revolution, nearly all production was powered by elbow grease—meaning we humans, and the animals we could enlist to help, provided the energy needed to make Stuff. That meant there was a limit to how many resources we could collect and how much Stuff we could make. Then in the late eighteenth and early nineteenth centuries we developed the steam engine, and soon machines could replace a lot of people, toiling harder and longer, without demanding things like safe working conditions or breaks to eat or rest.

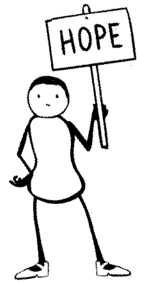
Suddenly the limits on how much Stuff we could extract and process disappeared, under the motto "more, faster, better." It was definitely more and faster, but not always better. The volume of resources moving through the system—both those used to power processes and those used as materials in production—increased dramatically. For example, in 1850, U.S. coal production was just under 8.5 million tons; by 1900 it increased to 270 million tons; and by 1918, it had reached 680 million tons.[182] A frontier mentality reigned: there would always be more forests to cut, more valleys in which to dump the waste. It seemed that there was no need even to think about limits back then.

Yet despite using more natural resources and making more Stuff faster, we needed less human labor. This raised a dilemma: if factories kept all the workers *and* introduced these new output-increasing machines, they would soon be producing more Stuff than people would need. (Economists call this overproduction, when production outpaces consumption.) There were two options: to ramp up consumption (more Stuff) or slow down production (more leisure). As I'll explain fully in the upcoming chapter on consumption, at that juncture America's business and political leaders unequivocally chose more Stuff.

The next wave of major change came in the early to middle twentieth century. This time it was on the materials front, as scientists began developing a whole new set of chemical compounds that hadn't previously existed. Many naturally occurring materials were replaced with synthetic petrochemicals. The volume and toxicity of chemical compounds used in production skyrocketed.

Of course the Industrial Revolution and modern synthetic chemistry have benefited us. I appreciate many things in my life that wouldn't have been possible without them. Refrigeration. A heated home. Medicine. The Internet. A tiny little device that brings music wherever I go. I don't want to do without these things and I don't want others to either. But it's time for another set of advances—another revolution.

Today we are running out of resources, while our population continues to grow. Yet our productive technologies have not kept up with this reality. We are still using processes that consume and waste huge amounts of energy and materials, acting as though both the supply of resources and the planet's ability to assimilate waste and pollution are endless. We're still celebrating economic activity that undermines the planet's very ability to support life. We have to figure out how to transform our production systems yet again: to make far less Stuff and far better Stuff.



Starting Upstream

The very first stage of production—way before we start the physical production—is the most important and least visible step: design. The design determines:

- which ingredients need to be extracted or created
- the amount of energy used in making and using the product
- the presence or absence of toxic chemicals
- the length of the product's life span
- the ease or difficulty of repair
- its ability to be recycled
- the harm caused by burying or burning the product if it's not recyclable

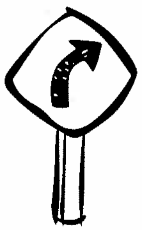
Architect Bill McDonough, an internationally renowned sustainability guru, calls design the "first sign of human intent."[183] Is our intent to make the cheapest-possible electronic gizmo to feed the latest consumer frenzy? Or is our intent to make a nontoxic, durable product made of ecologically compatible materials that provides a needed service, adds to society's well-being, can be easily upgraded and repaired as technology advances, and can ultimately be recycled or composted at the end of its life?

Changes in design can involve incremental improvements, like removing a particular toxin from use in one product line. Or the changes can be truly transformational, as a result of rethinking some of our long-held, and limiting, assumptions—our paradigms. For example, the assumptions that "pollution is the price of progress" or that "we must choose between jobs and the environment" have long limited our creative thinking about innovative solutions that can be good for the environment, the workers, and a healthy economy. We can't transform the system of Stuff unless we transform the way we think.

That said, it's good to remember that even incremental changes, when replicated over millions of consumer products, can make a difference. Getting lead out of gasoline, for example, had enormous benefits in protecting public health, especially the developing brains of children. That one change saved millions of IQ points worldwide. In February 2009, a group of mobile phone manufacturers and operators announced a commitment to design mobile phone chargers to be usable on any phone regardless of make or model, and to be far more energy efficient.[184]

I received news of this commitment while visiting Washington, D.C. Rushing to get ready for the trip, I had left my cell phone charger at home. I had a jam-packed week of meetings and was relying on my phone to ensure smooth logistics. Not wanting to buy a replacement charger for just a week's use, I asked the hotel if any previous forgetful guest had happened to leave behind a charger that would fit my phone. The desk clerk brought out a cardboard box with literally dozens of cell phone chargers, each neatly wrapped with their cords. I tried twenty-three chargers before finding one that fit my phone!

Changing the shape of the charger's jack is a small thing, but mobile phone industry representatives expect this simple design change could reduce the production of phone chargers by half, which in turn could reduce greenhouse gases in manufacturing and transporting replacement chargers by at least 10 to 20 million tons per year.[185] The mobile phone companies' press releases made interchangeable chargers sound revolutionary, but really, it could have been part of the original intent when cell phones were first being designed and developed.



One of the most exciting trends in truly revolutionary design is called biomimicry, in which design solutions are inspired by nature. After all, as the Biomimicry Institute notes, "nature, imaginative by necessity, has already solved many of the problems we are grappling with. Animals, plants, and microbes are the consummate engineers. They have found what works, what is appropriate, and most important, what lasts here on Earth. This is the real news of biomimicry: After 3.8 billion years of research and development, failures are fossils, and what surrounds us is the secret to survival."[186]

Biomimicry experts have identified the following list of core principles in how nature functions. Nature:

- runs on sunlight and uses only the energy it needs
- uses a water-based chemistry
- fits form to function
- recycles everything
- rewards cooperation
- banks on diversity
- demands local expertise
- curbs excesses from within
- taps the power of limits

Biomimicry takes these principles and figures out how to make human technologies, infrastructure, and products that adhere to them as well.[187]

What might this look like in practice? Janine Benyus, founder of the Biomimicry Institute, has endless examples. Rather than using toxic inks and phthalates to color Stuff, why don't we imitate the peacock, which creates the brilliant colors we see in its plumage through shape—layers that allow light to bounce off it in ways that translate as color to the eye. Instead of burning fossil fuels to heat up kilns for firing high-tech ceramics, we can mimic mother-of-pearl, which self-assembles a substance twice as strong as those ceramics in seawater: no heat required. The threads that hold a mussel to a rock dissolve after two years; the packaging we design can likewise be engineered to dissolve when it's no longer needed or wanted. Rather than mining virgin minerals, we can copy microbes that pull metals out of water.[188] Engineers and green chemists are already experimenting with all of these alternatives with success. They just need funds for continued research and development and government regulations on their side to achieve a full breakthrough.

Another revolution in the production of our Stuff is both necessary and possible. With existing and developing approaches, within a decade we could transform today's most destructive processes and eliminate the most toxic ingredients from our factories and products. With the government mandating this level of change, business people putting their money where their souls (and grandkids) are, and designers and scientists doing what they do best—innovate and improve!—we could be there in no time.