

Some materials have higher environmental and social impacts than others. Toxics, food, electronics and buildings require more resources and are more challenging to manage sustainably.

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CHAPTER 13 TOXICS

INTRODUCTION

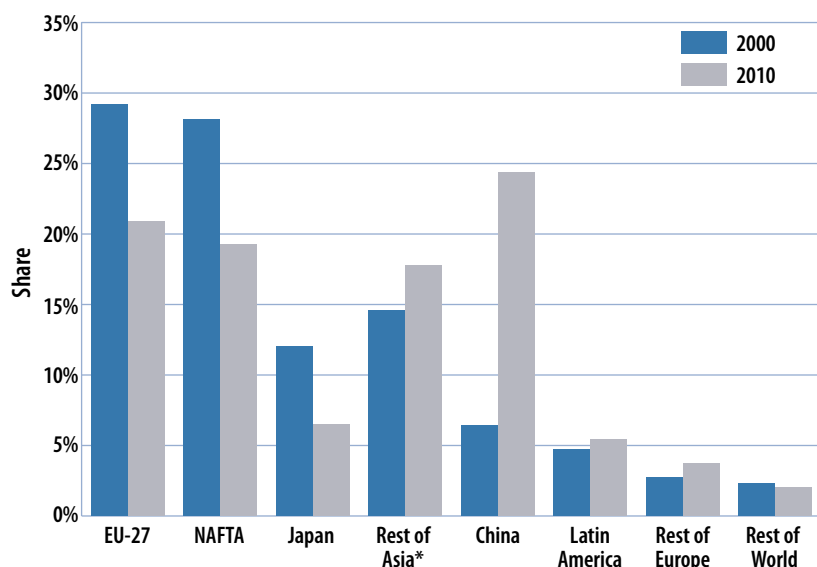
According to Aristotle, science begins with wonder: “It is owing to wonder that people began to philosophize, and wonder remains the beginning of knowledge.”

To begin wrapping your head around how chemicals and chemistry influence your life, first consider the electronic device you likely use every day for information, communication and entertainment. The chemicals and heavy metals used to make it are many; some are very toxic and some you may never have heard of. Here are just a few: brominated flame retardants, lead, chromium hexavalent, polyvinyl chloride (PVC), and phthalate esthers.

In 2018, global chemicals sales exceeded \$4 trillion. Fueled by emerging markets, world chemicals output has more than doubled over the last decade. This means that every single person in the world, on average, uses \$500 worth of chemicals a year. The main users of chemicals are in developed countries where each person uses approximately \$1200 worth of chemicals annually. (Data from the website of The Essential Chemistry Industry.)

In the United States, the chemical industry is one of the largest industries, an \$812 billion enterprise that creates hundreds of thousands of jobs. The products of chemistry are present in some form in nearly every facet of the American economy. In fact, over 96 percent of all manufactured goods are directly touched by chemistry.

WORLD CHEMICAL SALES



Unless specified, chemicals industry excludes pharmaceuticals. Unless specified, EU refers to EU-27.

* Asia excluding China and Japan.

Source: Cefic Chemdata International

CREDIT

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chemical policy, program evaluation, sustainable consumption, community-based social marketing, and government in-house sustainability.

TERM

Precautionary principle: *the principle that the introduction of a new product or process whose ultimate effects are disputed or unknown should be delayed until scientific consensus is established that it is not harmful.*

Chemical manufacturing creates products by transforming organic and inorganic raw materials through chemical processes. There are approximately 13,500 chemical manufacturing facilities in the United States owned by more than 9,000 companies. Facilities are located all over the country, with many companies in Texas, Ohio, New Jersey, Illinois, Louisiana, Pennsylvania, and the Carolinas. (Data from United States Environmental Protection Agency.)

With over 85,000 commercially produced chemicals, the chemical combinations in consumer products and their wastes are practically infinite. These products and byproducts bring us great benefits and also many negative consequences. Unfortunately, most chemicals have never been tested for possible health or environmental impacts. This creates significant health and environmental risks. (Data from the American Chemistry Council.)

There are two schools of thought when it comes to protecting the public from the potential harmful effects of chemicals. One is often called the **precautionary principle**. According to the precautionary principle the burden is on the manufacturer to prove that their new product or chemical is safe to expose to the public before they can introduce it commercially. U.S. regulations follow a second school of thought, markedly different from the precautionary principle. In the U.S., government and consumer advocates must identify problematic products and then prove that they cause harm. In practice, however, it is extremely difficult and costly to prove harm.

This chapter will explore the problems with current federal legislation in regards to toxics. It will also make the case that the cost of leaving laws as they are is significant in terms of human health and the environment.

This will entail an exploration of the health and environmental impacts of chemicals in the wrong places. After this initial examination of public health and environmental impacts we will shift our focus to individual lives. First we will explore where you are likely to encounter toxics in your everyday life. The final sections focus on strategies and personal choices that can very significantly lessen your exposure to toxic chemicals. You can minimize your use of hazardous products by buying only what you need and seeking out safer alternatives (whether store bought or homemade). We'll also discuss health considerations of plastics used in food packaging.

Master Recyclers can play a significant role in sharing this information so that more people in our region are empowered to make healthier personal choices. Master Recyclers are also well situated to participate in the conversation about changing the regulatory system so that community health comes first. With toxics infused in so many products around us, systemic change is necessary.

PROBLEMS WITH CURRENT POLICY

While chemicals and advances in chemistry have greatly improved our lives and welfare, some can have negative effects both on people and the environment. For example, some chemicals can pose serious risks if they are ingested or inhaled, some are known to cause cancer, and some are hazardous to the atmosphere. Unfortunately, because of the way the chemical industry is regulated, we know very little about most chemicals. In fact, we only know a good amount about just a handful of chemicals.

The federal Environmental Protection Agency (EPA) has access to only limited information about potential health or environmental hazards. And manufacturers have the right to withhold what they consider to be confidential business information. Because of this lack of information, in many instances it is impossible for the EPA to determine whether a chemical is safe or whether it poses a risk. With a weak federal regulatory structure, industry has little incentive to develop safer alternatives.

It is well documented that federal chemicals policy has not been effective in assessing chemical hazards or controlling chemicals of concern. Since the printing of this handbook, Congress passed reform legislation. Visit the EPA website to learn more.

A brief overview of current federal regulations governing chemicals and regulatory shortcomings will help set the stage for exploring possible state and local solutions.

FEDERAL REGULATIONS

Toxic Substances Control Act of 1976 (TSCA) provides EPA with authority to require reporting, record-keeping and testing, and to restrict chemical substances and/or mixtures if they are proven to pose unreasonable risks to public health or the environment. Certain substances are generally excluded from TSCA, including food, over the counter drugs, cosmetics and pesticides, among others. TSCA was amended in 2016 with the Frank R. Lautenberg Chemical Safety for the 21st Century Act. The Lautenberg Act strengthened TSCA in several key areas, including requiring review of existing chemicals in the market (not just new ones), strengthening the way risk assessments are done, calling for protection of vulnerable populations, and expanding testing authority and funding.

- Primary weaknesses:** Even with improvements made in 2016, TSCA remains inadequate to protect human health and the environment. Under the law, EPA must prove that a chemical poses unreasonable risk to public health or the environment before it can be regulated. When the law first passed, it allowed 62,000 chemicals remain on the market without testing. There are now 85,000 chemicals in the inventory required by TSCA to be managed by EPA. However, only 20 high priority chemicals are required to be evaluated for risk assessment at any given time, and the agency can take several years to evaluate each chemical. This means that only a small fraction of chemicals on the market will end up in review in the next century. Additionally, in deciding whether to approve chemicals under TSCA, the EPA does not holistically consider emission impacts from a chemical to air, water and land because these emissions are regulated by other laws.



DEEP DIVE



*More information about the **Toxic Substances Control Act (TSCA)** is available on the EPA's website.*



DEEP DIVE



*To learn more about what you can do about chemical policy and to follow recent proposals, visit the **Environmental Defense Act** website.*



More information about the **Federal Insecticide, Fungicide, Rodenticide Act (FIFRA)** is available on the EPA's website.

The Federal Insecticide, Fungicide, Rodenticide Act (FIFRA)

FIFRA provides federal control of pesticide distribution, sale and use. All pesticides used in the United States must be registered (licensed) by EPA. Registration assures that pesticides will be properly labeled and that, if used in accordance with specifications, they will not cause unreasonable harm to the environment. Use of each registered pesticide must be consistent with use directions contained on the label or labeling.

- **Primary weaknesses:** Provisions that restrict or prohibit information disclosure about the pesticide and pesticide application (for example, chemical composition or location of use) on the grounds that this is confidential business information.



More information about the **Federal Food, Drug, and Cosmetic Act (FFDCA)** is available on the EPA's website.

The Federal Food, Drug, and Cosmetic Act of 1938 (FFDCA)

FFDCA is a set of laws that authorizes the Food and Drug Administration to oversee the safety, effectiveness and marketing of foods, drugs, cosmetics and medical devices. The law has been amended many times.

- **Primary weaknesses:** FDA lacks sufficient resources to handle the number of violations it encounters. The FDA has come to rely heavily on the cosmetic industry to regulate itself. FDA regulation under the Act has primarily been limited to regulation of cosmetic products after their release into the marketplace; neither products nor ingredients are reviewed or approved before they are sold to the public.

CHEMICALS REFORM: EMERGING SOLUTIONS

In the absence of adequate federal regulations, other countries, states and even the chemistry profession itself, have been developing new and promising ways to tackle problems associated with chemicals.

European Union

In Europe, policy developments have, with a nod to the precautionary principle, shifted the burden of proof away from government and onto industry. The European Union's Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) regulatory framework requires registration by producers and users for an estimated 30,000 chemicals. Canada has also developed a Domestic Substances List that identifies more than 4,300 chemicals requiring further investigation for potential risks. This is great news for consumers worldwide since much of the information gathered from these programs will be universally accessible.

States, local and tribal governments

Recognizing the backlog in assessment and regulatory action at the federal level, a number of states have taken action. Of particular note are California's Green Chemistry Initiative, Washington's Children's Safe Product Act of 2008, and Massachusetts' Toxic Use Reduction Initiative.

The Interstate Chemicals Clearinghouse (IC2) has worked to coordinate these state efforts. The IC2 is an association of state, local, and tribal governments that promotes a clean environment, healthy communities, and a vital economy through the development and use of safer chemicals and products. The goals of the IC2 are to:

- Avoid duplication and enhance efficiency and effectiveness of agency initiatives on chemicals through collaboration and coordination.

- Build government capacity to identify and promote safer chemicals and products.
- Ensure that agencies, businesses and the public have ready access to high quality and authoritative chemicals data, information and assessment methods.
- Ensure that manufacturers will replace harmful chemicals with safer alternatives.

Oregon

Oregon's regulation and monitoring of toxic chemicals are fragmented among seven agencies, with little coordination. The safety of consumer products is a particular concern, as state agencies lack essential information needed to scientifically assess potential hazards. State tracking of exposure to toxic chemicals in communities and the workplace is incomplete and largely unanalyzed. There is a particular lack of data about health impacts on subpopulations — groups of people who may be more susceptible to risk if exposed. Some of these subpopulations also experience disproportionate exposure to chemicals.

In 2015, the Oregon legislature passed toxics reduction legislation aimed at protecting some of Oregon's most vulnerable residents. The Toxics Free Kids Act (Senate Bill 478) establishes a list of chemicals that harm children's health and:

- Requires manufacturers to notify health officials when their children's products (such as toys and car seats) contain these chemicals.
- Authorizes health officials to collect and track this data.
- Ensures manufacturers will replace harmful chemicals with safer alternatives.

At the local level, a number of local governments in Oregon have initiated and passed toxics reduction policy that influences such things as what products government buys and how government manages facilities and landscapes. For example, Multnomah County has adopted a Green Cleaning Policy for County Facilities, in 2014 Metro initiated an Integrated Pest Management Policy for Metro Properties, the City of Eugene banned specific pesticides on City properties through City Council Resolution and the City of Portland has toxic reduction goals associated with the city's Sustainable City Principles Policy.



DEEP DIVE

You can find more information on the Interstate Chemicals Clearinghouse on their website.

DEEP DIVE

To learn what you can do about Oregon Policy on toxics-free environment visit the Oregon Environmental Council.

TERM

Green chemistry: *The design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal. Green chemistry is also known as sustainable chemistry.*

CHANGE WITHIN THE INDUSTRY

While the role of government is changing, important changes are also taking place within the chemical industry itself. Traditionally, organic chemistry is taught in a vacuum. Chemists are taught how chemicals work without regard to the consequences of their use. There is no ethics course in the old school chemistry department.

Today in some academic settings, chemistry and the chemical enterprise are progressing towards a sustainable chemistry philosophy and practice. The federal Green Chemistry Research and Development Program promotes and coordinates federal research, development, demonstration, education and technology related to **green chemistry**.

Oregon is a leader in educating the next generation of more environmentally aware chemists. In 1998 the University of Oregon developed a groundbreaking approach to teaching organic chemistry that placed environmental concerns in the forefront. Since the development of UO's Green Chemistry Program, over 200 schools across the country have adopted the UO model, and the UO chemistry department has recently been enlisted by the National Science Foundation to share the program with institutions around the world. Perhaps as a result, Oregon also leads in some areas of greener chemicals, such as the design and development of chemical products and processes that reduce or eliminate the use or generation of hazardous substances.

TOXIC IMPACTS OF CHEMICALS IN THE WRONG PLACE

Chemicals are not static. Rather they move through the environment throughout their life cycle (production, transport, use and disposal). And they often move in unintended and unexpected ways. It is difficult to fully understand the toxic impact of individual chemicals at these myriad points; and we are just beginning to consider the impact of the almost infinite combination of chemicals on living organisms and the planet. It is clear, however, that there are significant public health impacts from chemicals and that chemical contamination is widespread.

Public and governmental awareness of how chemicals can increase cancer risk and other negative health outcomes has increased substantially in recent years as scientific and health care communities, policymakers, and individuals strive to understand and ameliorate the causes and toll of human disease. A growing body of research documents established and suspected environmental factors (including chemical contamination) linked to genetic, immune and endocrine dysfunction that can lead to cancer and other diseases.

While all Americans now carry many foreign chemicals in their bodies, women often have higher levels of many toxic and hormone-disrupting substances than do men. Some of these chemicals have been found in maternal blood, placental tissue, and breast milk samples from pregnant women and mothers who recently gave birth.

Research on chemical contaminants in breast milk spans several decades and dozens of countries. The ability to use this research as an environmental indicator is limited because of a lack of consistent protocols. For example, most studies have focused only on a small panel of persistent organic pollutants, despite indications that a wide range of additional chemical contaminants may also enter breast milk. Despite these shortcomings scientists have detected many different chemicals in breast milk throughout the world. Chemicals often tested for and found in breast milk globally include: organochlorine pesticides, polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs), polybrominated diphenyl ethers (PBDEs), metals, and solvents. This substantial body of research shows that chemicals often end up in the wrong place — in this case in human breast milk.

Humans and all other organisms are exposed to many chemical mixtures present in the surrounding environment (water, air, soil), in food or in consumer products. However, with a few exceptions, chemical risk assessment considers the effects of single substances in isolation, an approach that is only justified if the exposure to mixtures does not bear the risk of increased toxicity. This would be the case, for example, if only one chemical of the mixture is toxic while the others are biologically inert.

However, there is strong evidence that chemicals with common specific modes of action work together to produce combination effects that are larger than the effects of each component applied singly. Fewer studies have been conducted with mixtures composed of chemicals with diverse modes of action, but results clearly point in the same direction: the effects of such mixtures are also higher than those of the individual components. Recent research shows that this applies to a host of different endpoints of relevance to mammalian toxicology and ecotoxicology, and holds true for a diverse set of chemicals.

“The question is not whether we should feed our babies chemically contaminated, yet clearly superior, breast milk or chemically un-contaminated, yet clearly inferior, formula. The question is, what do we need to do to get chemical contaminants out of clearly superior breast milk?”

Sandra Steingraber,
Having Faith: An Ecologist’s
Journey to Motherhood.

HEALTH IMPACTS OF TOXICS

Asthma inducing toxics

Asthma, a chronic lung disease that narrows and inflames airways, is often triggered by airborne chemicals. Nearly 27 million Americans have at one time in their lives been diagnosed with asthma by a physician. People of all ages have asthma; it occurs in all countries and among all populations around the world. Over the past 20 years, asthma has become increasingly common in many parts of the industrialized world. We are in the midst, some physicians would say, of an “asthma epidemic” and increased chemical exposure is likely one of the drivers of this.

The causes of asthma are not fully understood. Its symptoms are caused by inflammation, which makes the airways red, swollen, narrower and extra-sensitive to irritants. Asthma is probably usually caused by a mixture of hereditary factors that you are born with and environmental factors. But how these factors work together is still largely unknown.

There are many environmental asthma triggers and some come easily to mind: secondhand smoke (composed of as many as 7,000 chemicals, 250 of which are known to be harmful, and at least 69 of which cause cancer), outdoor air pollution (small particles and ground level ozone from car exhaust, road dust and factory emissions), mold, dust mites, and smoke from wood-burning stoves and fireplaces (which contains a mixture of harmful gases and small particles).

At sufficient concentrations in the air, many chemicals in any number of products in your home can trigger an asthmatic reaction. As well, asthma can be worsened by the presence of products such as cleaners, paints, adhesives, pesticides, cosmetics and air fresheners.

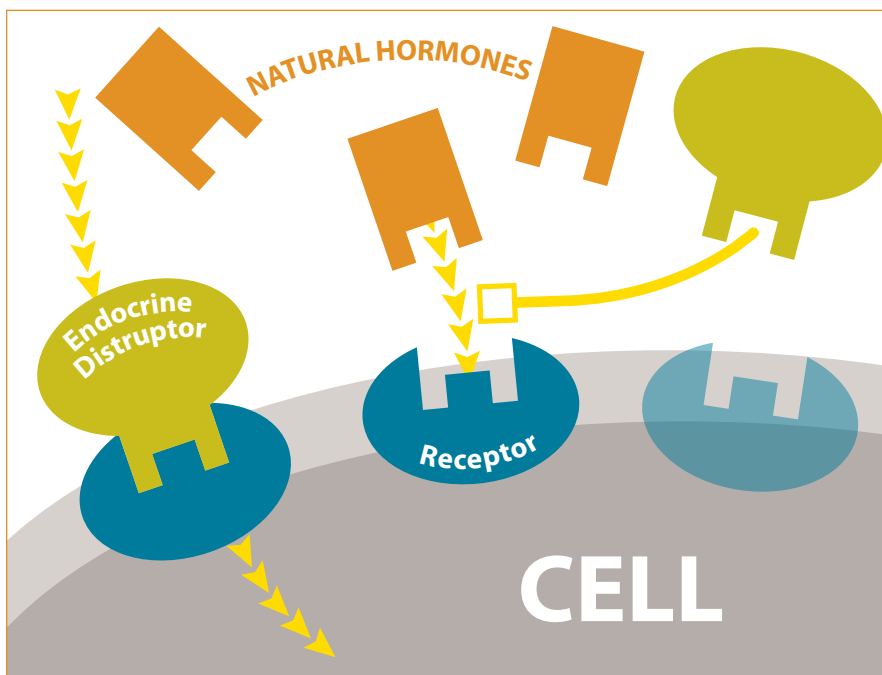
Perhaps one of the most ubiquitous groups of chemicals that can be found in indoor air is the fragrance chemicals. People who have asthma may be more sensitive to fragrances and may experience allergy symptoms, or worsening asthma symptoms, from exposure to perfumes, fragrances, and other chemicals. Once the primary arena of the perfumer and derived primarily from natural sources, synthetic fragrance development is a growing multi-billion dollar industry. Fragrances can be found in most products. They are used to add flavor or scent to a product or to mask a product’s unpleasant smell. They may come from natural (animals or plants) or synthetic sources. Consider the variety: perfumes and colognes, scented candles, facial tissue and toilet papers, household cleaners, car care products, soaps, cleansers, cosmetics, detergents, hair care products, creams and lotions, fabric softener and some foods and beverages.

Hormone and endocrine disruptors

Endocrine disruptors are chemicals that can interrupt the healthy functioning of the human body by preventing hormone systems from working properly. Hormone systems, also referred to as endocrine systems, are found in all mammals, birds, fish, and many other types of living organisms and are essential for most biological processes.

Simply put, the endocrine system is a network of glands that secrete chemicals called hormones to help your body function properly. This system regulates all biological processes in the body from conception through adulthood and into old age. Hormones interact with cells that contain matching receptors on their surfaces. The hormone binds with the receptor, much like a key would fit into a lock. The hormones, or keys, need to find compatible receptors, or locks, to work properly. Once a receptor and a hormone bind, the receptor carries out the hormone's instructions.

Chemicals in the environment can disrupt the endocrine system in a variety of ways. For example, some chemicals mimic natural hormones, fooling the body into over-responding to the stimulus or responding at inappropriate times. Other endocrine disrupting chemicals block the effects of a hormone from certain receptors. Still others directly stimulate or inhibit the endocrine system and cause overproduction or underproduction of hormones. Certain drugs are used to intentionally cause some of these effects, such as birth control pills. In many situations involving environmental chemicals, however, an endocrine effect is not desirable nor is it intended.



When absorbed in the body, an endocrine disruptor can decrease or increase normal hormone levels (left), mimic the body's natural hormones (middle), or alter the natural production of hormones (right).

The Dirty Dozen of hormone disrupters:

- BPA
- dioxin
- atrazine
- phthalates
- perchlorate
- fire retardants
- perfluorinated chemicals
- glycol ethers
- organophosphate pesticides.

In recent years, some scientists have proposed that chemicals might inadvertently be disrupting the endocrine systems of humans and wildlife. A variety of chemicals have been found to disrupt the endocrine systems of animals in laboratory studies, and there is strong evidence that chemical exposure is associated with adverse developmental and reproductive effects on fish and wildlife in particular locations. The relationship of human diseases of the endocrine system and exposure to environmental contaminants, however, is poorly understood and scientifically controversial.

There is growing recognition in the scientific community, however, that exposure to even low doses of certain chemicals, particularly in the womb or during early childhood, can disturb our hormonal, reproductive, and immune systems, and that multiple chemicals can act together to harm human health.

Of the many known and suspected endocrine disruptors, Bisphenol A (BPA) has received perhaps the most public attention in recent years. BPA is used in numerous plastic products, including baby bottles, and food and beverage can liners. It disrupts the endocrine system by mimicking the estrogen hormone. Extensive research has linked the disruption from BPA to breast cancer, obesity, diabetes and other serious medical problems.

Cancer causing toxics

Despite overall decreases in incidence and mortality, cancer continues to shatter and often steal the lives of Americans. Approximately 41 percent of Americans will be diagnosed with cancer at some point in their lives, and about 21 percent will die from cancer. The incidence of some cancers, including some most common among children, is increasing for unexplained reasons.

Factors impeding control of environmental cancer risks include limited research on environmental influences on cancer; conflicting or inadequate exposure measurement, assessment and classification; and ineffective regulation of environmental, chemical and other hazardous exposures.

Known carcinogens: arsenic, asbestos, benzene, bisphenol A (BPA), chromium hexavalent compounds, dioxins, formaldehyde, polybrominated diphenylethers (PBDE), polycyclic aromatic hydrocarbons (PAHs) and vinyl chloride.

Toxics that affect brain development

According to the U.S. Centers for Disease Control and Prevention (CDC), about 1.8 million more children in the U.S. were diagnosed with developmental disabilities between 2006 and 2008 than a decade earlier. During this time, the prevalence of autism climbed nearly 300 percent, while that of attention deficit hyperactivity disorder increased 33 percent. CDC figures also show that 10 to 15 percent of all babies born in the U.S. have some type of neurobehavioral developmental disorder. Still more are affected by neurological disorders that don't rise to the level of clinical diagnosis.

While earlier and more rigorous diagnosis accounts for some of this increase, it doesn't explain all of it. Researchers credit genetic factors for 30 to 40 percent of the cases. But a growing body of research suggests that exposure to environmental pollutants is implicated in the rise in children's neurological disorders. The benefits of avoiding exposure to known, suspected or potential neurotoxicants are clear.

For a brain to develop properly, neurons must move to precise places in a precise sequence. They do so under the direction of hormones and chemical neurotransmitters. The process is an intricate, fast-paced dance on a very tiny scale. At any point, neurotoxins have the potential to disrupt this dance, in a slight or serious fashion.

One of the main problems in studying the effect of chemical exposures on subsequent brain function is the possibility of a long latency period between exposure and recognition of functional deficit. For example, impaired language or reading skills may not become apparent until school age.

Our understanding of what constitutes safe thresholds of known neurotoxins has been continually revised downward as scientific knowledge advances. For example, the initial safe level of blood lead was set at 60 micrograms/dl in 1960. That was revised to 10 micrograms/dl in 1990, and by 2012 that number was 5 micrograms/dl. Today, no safe blood lead level has been identified. Any lead in blood for children is shown to affect IQ. It is estimated that over half a million U.S. children (ages 1 to 5) have blood lead levels at, or above, 5 micrograms/dl.

Classifying human neurotoxins can be tricky and expensive. While laboratory research has identified more than 1,000 chemicals to be animal neurotoxins, the known list for humans is small by comparison. Only 214 chemicals have been classified as human neurotoxins, and only 12 have been identified as affecting fetal and child development. Much more research is needed in these areas, and as this occurs, the list of known neurotoxicants will likely grow dramatically.

Even if developmental toxicity can be measured in lost IQ points during childhood, it is much more difficult for researchers to explore the impacts of chemicals in later life. Could in-utero exposure increase the chance of developing neurodegenerative diseases like dementia? And if the effects do not show up until a person's sixth decade, will we continue to expose future generations to these chemicals?

The Dirty Dozen for Child Development:

- *methylmercury*
- *polychlorinated biphenyls*
- *ethanol*
- *lead*
- *arsenic*
- *toluene manganese*
- *fluoride*
- *chlorpyrifos*
- *tetrachloroethylene*
- *polybrominated diphenyl ethers*
- *dichlorodiphenyltrichloroethane*

TOXICS IN THE ENVIRONMENT

Air quality and climate change

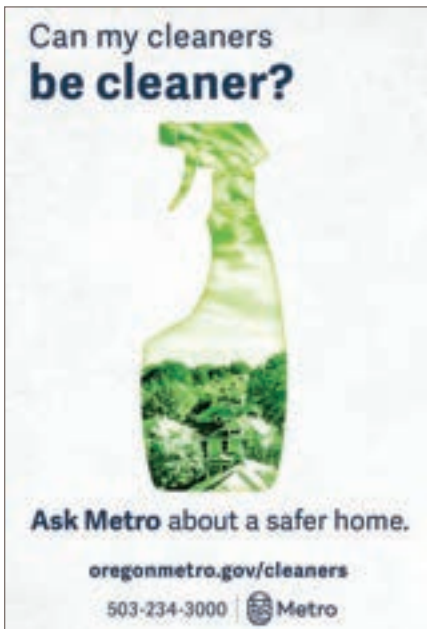
The United States chemical sector produces many negative environmental impacts. It is one of the largest users of natural gas, which is required for energy and as a feedstock. In 2011, the chemical industry emitted more than half a million tons of criteria air pollutants, of which more than 70 percent were carbon monoxide (CO), sulfur dioxide (SO₂), and nitrogen oxides (NO_x). The industry also manages a huge amount of chemicals that are reported to EPA's Toxic Release Inventory. About 5 percent of the more than 10 billion pounds of chemicals managed are disposed of or otherwise released to air and water, while the rest goes to treatment, energy recovery, and recycling.

Like many global industries, the primary environmental impacts of the chemical industry are through the industry's extensive consumption and combustion of fossil fuels used to produce and use chemicals. Most people are aware of the costs of toxics to the environment and public health. Many are less aware that one of the largest negative impacts from the production and use of chemicals is its impact on the earth's climate. Researchers, using life cycle assessment methods, have calculated that energy-related factors account for 40 to 80 percent of this industry's negative environmental impact primarily due to the effects they have on the climate.

Soil and water quality

The production, use, and management of waste chemicals also causes much destruction of natural habitat and decreases soil and water quality. Once in the food chain, many of these substances are accumulated to ever-higher concentrations in the tissue of the animals that consume them. These impacts include the following:

- As global population increases so too does the demand for food and industrialized farming. Industrial farmers often use chemical fertilizers and pesticides to kill and suppress insects, fungi and bacteria. This reliance on chemicals comes with an environmental cost to both soil and water quality.
- During the extraction phase of chemical fuels and metals, drilling and mining activities destroy whole landscapes and pollute water systems.
- Household cleaning and disinfecting products are flushed into sewage systems and out through treatment plant discharge, or are washed from property and septic tanks into groundwater and streams.
- In industrialized nations, each household produces tons of garbage each year. Much of that garbage is made from products containing chemicals. Although some of this waste is recycled the majority of it remains in landfills or litters urban and natural landscapes.



WHERE TOXICS ARE FOUND

Consumable and durable products

Consumable goods, also known as nondurable goods or consumables, are those goods that are capable of being consumed, wasted, dissipated, used up or spent. Consumables are products that consumers use recurrently, that is, items which get used up or discarded. These kinds of chemical goods include solvents, personal care products, pesticides, glues and adhesives, pharmaceuticals, fuels and ink cartridges.

Durable goods are a category of consumer goods that do not have to be purchased frequently. As the name suggests, such goods have an extended product life (three years or more) and are not typically worn out or consumed quickly when you use them. Almost all durable goods contain or are manufactured using chemicals. Durable goods include: consumer electronics, carpets, furniture, clothing, toys, building materials and many other products.

Personal care products



The text in this section comes from the report by the Oregon Environmental Council and Metro, *What's in my Makeup Bag?!* The full text is available online.

Personal care products include any product that is put on the body to cleanse, enhance, or cover up one's natural features. They include shampoos, conditioners, soaps, lotions, perfumes and colognes, as well as makeup and hair color.

Nanomaterials

By some estimates, women who use personal care products every day are exposed to dozens of toxic chemicals in these products. Women of reproductive age use twice as many personal care products in more combinations than men, resulting in daily exposures to higher levels of toxics through their use.

While the chemicals in these products exist in small amounts, exposure occurs every day and in multiple combinations through the use of a variety of personal care products. These exposures add up. The scientific community is just beginning to uncover what these multiple and cumulative exposures mean for our health.

Independent scientific researchers have found many unregulated and untested chemicals among the 10,000 ingredients widely used in personal care products. Some chemicals known to have toxic properties, including formaldehyde, phenoxyethanol, and parabens, are used as preservatives in personal care products. Some of these chemicals are known carcinogens, endocrine disruptors and neurotoxins. Studies indicate that these chemicals end up in our bodies.

The market for personal care products is strong, but regulation of the industry is weak. In the U.S., personal care product companies generate billions of dollars of revenue a year. Four personal care product companies are on the 2010 Fortune 500 list with company revenue ranging from \$7.3 to \$79.7 billion. Personal care products, however, are among the least-regulated products under the United States Food and Drug Administration's authority. The FDA requires personal care products to carry labels identifying ingredients by order of prominence. But fragrances and trade secret ingredients are exceptions to this requirement. If a manufacturer tells the FDA that their ingredients are secrets important to the product and its profitability, the manufacturer does not have to list those ingredients.

Nanotechnology, the manipulation of matter on an atomic, molecular, and supramolecular scale, is a relatively new science that is being applied in a variety of fields, including: chemistry, physics, biology and engineering. Research and development in these fields is leading to new products and nanomaterials with applications in pharmaceuticals, electronics, coatings and chemical remediation.

Nanomaterials are extremely small (a nanometer is one millionth of a millimeter, approximately 100,000 times smaller than the diameter of human hair) and can exhibit unique characteristics that are leading scientists to question what implications they may have on our health. Nanoscale materials can, in theory, be engineered from minerals and nearly any chemical substance, and they can differ with respect to composition, primary particle size, shape, surface coatings and strength of particle bonds.

Much of what is known about their health effects comes after decades of understanding the effects from natural or incidentally formed nano-sized materials such as ultrafine particles from dust or incomplete combustion. Unfortunately, much is still unknown and research is needed to determine whether exposure to manufactured nanomaterials can lead to adverse effects on the heart, lungs, skin; alter reproductive performance; or contribute to cancer.

Given what we know, caution is warranted. Nanomaterials may enter the body by routes not typical for other chemicals because of their small size. If nanomaterials of certain sizes are able to enter the body, they may pass through cell membranes or cross the blood-brain barrier because of their small size. When used for drug delivery and disease treatments this can be beneficial. But, this could also result in unintended impacts for manufactured nanomaterials not designed for disease therapies. Nanomaterials may also interact with environmental media and pollutants to produce by-products that may have the potential to negatively affect the health of humans and wildlife.

With the global nanotechnology market expected to reach \$27 billion by the end of 2015, it is increasingly essential that we more fully understand the potential human health risk of manufactured nanomaterials.

PERSONAL CHOICES CAN MAKE A DIFFERENCE

Everyone can make thoughtful and more informed choices about the products that they buy and use. Whether we are choosing paint for the baby's room, sunscreen for the toddler, carpeting for the master bedroom, wallboard for the new renovation project, fertilizers for the yard or furniture for the living room. Taking time with these choices can help us steer clear of products with unwanted chemicals in them. Master Recyclers can play an important role in understanding these choices and empowering the community to make healthy and safe choices.



Toys with phthalates



Cathy Bloom was 36 when she volunteered to participate in Oregon Environmental Council's Pollution in People Project (2007). The study selected a small diverse group of Oregonians to test for a select group of six chemicals. The report explains: "Cathy's main motivation to participate in this study was to help educate the general public about toxic chemicals, especially around choices that can be made during pregnancy and while nursing. When she was pregnant with her first child, she wasn't aware of the potential health hazards in some consumer products. With her second child, Cathy knew of the dangers of phthalates and bisphenol A and made the choice to avoid them when possible." Cathy had the fewest number of chemicals detected in her body in this report. She was one of two participants with no detectable bisphenol A and her total phthalates level was less than half of the second lowest participant.

DEEP DIVE

You can find the Oregon Environmental Council's **Pollution in People** report online.



RESOURCE

Learn the LD50 of any pesticide chemical on the National Pesticide Information Center's website or by calling 1-800-858-7378.

Identifying hazards

Read the label! Look for these signal words: danger, warning or caution. These federally mandated words indicate the degree of immediate hazard posed by a product. Generally, danger indicates that a product is extremely hazardous because it is poisonous, extremely flammable, or corrosive. Warning or caution on labels indicates products that are somewhat less hazardous, but which still require precautions in their use and waste disposal. Products not listing these signal words are usually the least hazardous.

The chemical industry evaluates toxicity by determining what the lethal dose is for 50 percent of laboratory test animals (LD50) exposed to the product to die.

Product labels can provide clues to the hazard of the product. A product is hazardous when it contains one or more of the following properties:

- **Flammable/combustible** – can easily be set on fire or ignited.
- **Explosive/reactive** – can detonate or explode through exposure to heat, sudden shock or pressure.
- **Corrosive/caustic** – can burn and destroy living tissue.
- **Toxic/poisonous** – capable of causing injury or death.
- **Radioactive** – can damage or destroy cells and chromosomal material.

All products with these characteristics should be handled with care and attention given to the directions on the label.

Safely using hazardous products

Sometimes there are no satisfactory alternatives to household hazardous products. When this is the case, it is important to select the products carefully and use them safely. Here are some tips for selection and use:

Buy only what you need. How much do you actually need? If it's a small amount, see first if you can borrow it from a neighbor. Don't purchase the economy size to save a few cents per unit if that will create a future storage or disposal problem. Instead, buy the quantity that best fits your immediate need and share what's left with a neighbor or friend. Do not, however, give away old pesticides because they can contain chemicals that are now banned (for example, DDT, Kelthane). **Always follow label directions and use only the amounts indicated.**

Wear protective clothing when directions call for it. Gloves, goggles and long sleeved shirts can prevent direct contact with chemicals and absorption through the skin. Respirators and dust masks prevent inhalation of particulates, mists, vapors and fumes.

Use products in well ventilated areas. Avoid breathing fumes and keep containers tightly closed to prevent evaporation. Use products outdoors when possible. When indoors, open as many windows and doors as possible to provide maximum air circulation. Position a fan between your work area and an open door or window with the fan pointed outward to pull the fumes or vapors away from the work area and circulate fresh air into the room. A kitchen or bathroom exhaust fan or one open window will not provide adequate ventilation.

The small size of aerosol particles makes it easy for them to be inhaled deeply into the lungs and quickly absorbed into the bloodstream. Aerosol cans are also explosive when exposed to heat or pressure.

Never mix chemical products. Mixing hazardous products can start a chemical reaction that could create highly toxic fumes or even cause an explosion.

Store hazardous products safely. Store unused portions of products in their original container, tightly sealed. Identify the area where you keep toxic products by permanent marker. Keep items high so that if there is flooding the materials do not contaminate water, and far away from hot water heaters and furnaces to avoid potential explosions if there is a fire.

Store toxic products out of reach of children and pets. If a poisoning occurs, immediately call a doctor or the Poison Control Center at 800-222-1222. First aid advice and antidotes on the product labels are sometimes incorrect.

Disposing of hazardous products

People dispose of hazardous household products in many different ways. They flush them down drains and toilets; toss them into the garbage; pour them down storm drains, on driveways or streets; and they dump them illegally. None of these are safe ways to dispose of hazardous products. To understand why, it is helpful to understand what happens to the waste when it goes away.

Risk to the environment

In the Metro region, most garbage is transported to the state-of-the-art Columbia Ridge Landfill in Arlington, Oregon. The hazardous waste goes to a separate facility next to the general landfill.

Some hazardous products will eventually degrade into harmless elements, but others will not. In a landfill, they will be more concentrated than if used uniformly in the environment. Although the hazardous waste landfill is also state-of-the-art, specially regulated and engineered, there is always the potential for hazardous chemicals to end up where they can cause harm.

Hazardous wastes should never be diluted and flushed down an inside household drain or street drain. At sewage treatment plants, bacteria are utilized to break down organic solids in the water. Most toxic wastes cannot be processed in this way. Many can damage the sewage system and kill the helpful bacteria needed to treat sanitary waste. After the bacteria breaks down organic solids at the treatment plant, water is returned to the natural waterways, along with any toxic chemicals that people put down the drain.

Do not flush any product if you are on a septic system. Toxic substances in the septic system can kill the helpful bacteria in the tank and percolate through the drain field into the soil where they can contaminate groundwater and local wells.

Responsible disposal

Although collection opportunities are many in the Portland metro area, household hazardous waste is still found in the trash. Fortunately, the prevalence of this is declining as access to hazardous collection opportunities has improved. Research in 2015 shows that the percentage of hazardous waste in the household garbage amounts to .21 percent. This is a small but not insignificant amount, adding up to about four million pounds derived from total regional tonnage.



Two transfer stations presently accept most of the region’s hazardous waste: You can take your toxic trash to Metro’s permanent hazardous waste facilities year-round. Closed on major holidays

Metro Central	Metro South
6161 NW 61st Avenue, Portland (between Front Ave. and St. Helens Rd.) Open 9 a.m. – 4 p.m., Mon-Sat, closed Sun	2001 Washington Street, Oregon City Open 9 a.m. – 4 p.m., Daily

Call 503-224-3000 for more information.





Metro recycles as many wastes as possible, including latex paints, antifreeze, motor oil, lead acid batteries, some household batteries and metal containers.

Metro schedules community collection events across the tri-county area. These events are smaller, scheduled frequently and community-friendly.

Free household hazardous waste collection events take place from 9 a.m. to 2 p.m. every week (except Memorial Day, Fourth of July and Labor Day weekends) between early March and mid-November in many communities across the Portland metropolitan area. Call Metro, 503-234-300 for details.

Back to basics

Keeping things simple is our best defense, because it lets you know more fully what you are exposing yourself and your surroundings to. To start getting back to basics you can take an inventory of all the chemicals you have in your home. These are those consumable products that are under your kitchen sink, in your garage, and on the shelf in the bathroom. Familiarize yourself with what you have. Read the labels. Consider getting rid of the most hazardous products first. Do you have any products that you don't really need? Do you really need three types of cleaners for the bathroom? Consider how many fewer chemicals will be in your bathroom airshed if you use one product instead of three.

Some of the most hazardous chemicals used in our homes are pesticides. Many are designed to kill anything that moves rather than specific targets. Tackle a pest or problem (i.e. ants, spiders, mice) one at a time. Identify first and know thy enemy. Take the time to figure out where the pest is coming



RESOURCE

For pesticide free gardening advice visit Metro's **Yard and Garden** web resources.

RESOURCE

Search more than 70,000 personal products at EWG's (Environmental Working Group) **Skin Deep cosmetics database**, available online.

in and seal that area off. It may take some sleuthing, but eventually you will keep that pest out. Remember, pesticides kill living things and they are probably not the chemical you want to spray on your kitchen counter.



A clean house doesn't need to smell like a packaged fragrance. Reconsider all the products you use that have fragrances as part of their chemical makeup. Also, choose products that are water-based and not solvent-based. This will help the air quality in your home. Durable goods also off-gas adhesives and other volatile organic chemicals. When you are thinking about bringing new carpets and furniture into your home consider what the product is made of. Natural fiber products may be a better air quality choice. And look for stuffed furniture that doesn't contain flame retardants. Often you can pay for a couch spill warranty and not have to spray scotch guard on your couch.

A home garden should be a place of beauty, play and rest. There are many resources in our community and on the web that can help you garden without pesticides.

Your skin is the largest organ of your body; take care of it by keeping chemicals away from it. Be selective about your personal care products. Minimizing how many products you use will help you steer clear of chemicals that may not be good for you. Take time to do the research required to understand your choices.



RESOURCE

For safe cleaning tips visit **Metro's Green Cleaning** web resources. You can also Google **Body Care Recipes** for all sorts of ideas for homemade shampoos, lotions and creams.

Greener cleaners

Often people want names of alternative, greener cleaning products. Unfortunately, it is not that easy. No regulations exist that define what can be labeled as non-toxic, safe or green. Products that state that they are natural or non-toxic may still have chemicals in them that simply have not yet been proven to be unsafe. Product labels are also allowed to hide ingredients that are claimed to be trade secrets.

For this reason, a back to basics list of seven ingredients that you can use to clean your house is the best. However, if you are seeking a more specialized product, it is easy and incredibly cheap to make your own.

Use these seven ingredients to keep your house clean:

Baking soda (sodium bicarbonate). Absorbs odors and is a mild abrasive. Found in the baking section of the grocery store.

Essential oils deodorize or add scent. Mint, eucalyptus, lavender, lemon, tea tree and other oils can be found in the natural food section of many grocery stores or herbal supply shops.

Glycerin. An antiseptic and moisturizes the skin. Found in pharmacies or in some grocery natural food sections. Use vegetable oil-based glycerin.

Hydrogen peroxide is a disinfectant. Use the 3 percent household concentration, found in pharmacies.

Vegetable oil-based liquid soap or detergent. Sometimes referred to as castile soap. Found in many grocery natural food sections.

Vinegar. Removes soap scum, grease and mineral deposits and acts as a deodorizer. Use white distilled vinegar for most of these recipes. Found in the condiments aisle of the grocery store.

Washing soda (sodium carbonate). Removes grease and is slightly caustic. Found in the laundry section.

KNOW YOUR FOOD PLASTICS

Unfortunately, plastics labeling only identifies the main resin used. There may be any number of additional unnamed chemicals. Furthermore, there is a lot that is not known or fully tested about each plastics resin. However, there are some that are known to be worse, and there are ways to minimize potential risk.



Three steps to safer use of food plastics

1. Avoid the known problem plastics.

- **Polycarbonates contain Biphenol A (BPA)** which is a known hormone disrupter that can cause cancers and developmental problems. These plastics are labeled #7 (however #7 is used for other resins as well). BPA was used in baby bottles and water bottles, but public awareness has led companies to seek alternatives. In some states it is illegal to use BPA in baby products.
- **Polystyrene (#6)** is toxic to the brain and nervous system to workers exposed to it over a prolonged period. This resin is mostly found in take away containers and Styrofoam™.
- **Polyvinyl chloride, also known as vinyl or PVC (#3)**, poses risks to the environment and human health. Its manufacture is highly toxic, and its use requires additional toxic stabilizers. This plastic is mostly found in cling wraps.
- **Phthalates** are hormone disruptors. They are additives in products and packaging such as baby toys, flooring and cling wrap that makes plastic pliable. Because they are additives rather than a resin, they do not have a plastic number. Almost all very flexible plastics have phthalates in them.

2. **Minimize leaching or off-gassing.** Plastic numbers 1, 2, 4 and 5 appear to be fairly stable when at room temperature. However, heating plastics may cause chemicals to seep into the food or release chemicals into the air. Take foods out of plastic packaging and place on ceramic or pyrex glass before microwaving. Avoid extreme temperatures in the dishwasher. If you plan to reuse the plastic, wash it by hand in tepid water. Avoid storing fatty foods in plastic as fats can also absorb plastic chemicals more easily.
3. **Use alternatives to plastics.** Drink tap water from a reusable (BPA-free) water bottle or a glass, and bring food to work in your own glass or metal container.



CONCLUSION: REFORMING A FAILED SYSTEM

In this chapter we have offered an overview of toxics, a complicated and potentially overwhelming topic. We hope you now have a basic understanding of current regulations and of the health impacts of toxic chemicals. You are now also hopefully familiar with the environmental impacts of chemical production and where you are likely to encounter toxics in your daily life. The final section of this chapter presented some strategies that Master Recyclers and others can use to lessen their exposure to toxics. You can: inventory toxic products already in your home; consider safe disposal of unneeded toxic products; always follow safety guidelines when using hazardous products; use simpler products (whether store bought or homemade) with known ingredients; and minimize your use of plastics for food packaging and handling.

While personal action can make a real difference, our current regulatory system is broken. Given this, you can demand new laws that protect our environment, workers and personal health. The country's main chemical safety law -- the Toxic Substances Control Act (TSCA) -- makes it nearly impossible for the Environmental Protection Agency (EPA) to take regulatory action against chemicals, even those that are known to cause cancer or other serious health effects.

When TSCA became law in 1976, the goal was to ensure the safety of chemicals from manufacture to use and disposal. But weaknesses in the law have left the EPA largely unable to act on known health dangers or require testing on specific chemicals that may be unsafe.



As Oregonians, we should also support reform that allows states to maintain laws which exceed federal protections to safeguard their residents. You can familiarize yourself with the federal law and learn the positions of the groups that are working on reform. You can support TSCA reform through personal action (for example, writing to your Senator) or join an organization. Here are some organizations working on chemical reform:

- **The Safer Chemicals, Healthy Families coalition** represents more than 11 million individuals and includes parents, health professionals, advocates for people with learning and developmental disabilities, reproductive health advocates, environmentalists and businesses from across the nation.
- **The American Chemistry Council's mission** is to deliver business value through exceptional advocacy using best-in-class member performance, political engagement, communications and scientific research.
- **Safer States** (based in Portland) is a network of diverse environmental health coalitions and organizations in states around the country that share a bold and urgent vision. "We believe families, communities, and the environment should be protected from the devastating impacts of our society's heavy use of chemicals. We believe that new state and national chemical policies will contribute to the formation of a cleaner, greener economy."

All of the above organizations have websites where you can find more information.

Local and regional action can also influence the changing landscape of chemicals policy. Closer to home, the Oregon Environmental Council, Neighbors for Clean Air, Beyond Toxics, and Physicians for Social Responsibility (Oregon Chapter) all work in the realm of toxics reduction. You can search online to find out more about any of these organizations and discover ways to add your voice to the conversation.

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CHAPTER 14 FOOD

INTRODUCTION

From the grocery store to the White House, America is in the midst of a food revolution. People are eagerly seeking out new foods and demanding to know both how and where their food is grown. They are asking tough question about the modern food industry's adverse impacts on our personal health, on workers and on the planet as a whole. Former First Lady Michelle Obama even made it her personal mission "to change the way a generation of kids thinks about food and nutrition."



As interest in food grows, so too do concerns about food waste. The United Nations estimates that 30 to 40 percent of food in the United States is wasted and they established a World Food Day to address food waste and other pressing food issues. The United Kingdom, Environmental Protection Agency, Natural Resources Defense Council and other organizations are making headway in identifying the underlying causes of food waste and creating programs and policies to address these causes.

What they are finding is it's not just farmers, grocery stores, or other pre-consumer steps in the food-supply chain that are causing food waste. In fact, it's estimated that twice as much food is wasted at the consumer stage than at the retail stage. According to the U.S. Department of Agriculture, an American family of four throws out close to \$1,882 worth of food every year.

This chapter was written collaboratively by Steve Cohen and Master Recyclers Sara Harding Mihm (Class 59) and Alex Mihm (Class 62). Steve manages food policy and programs for the City of Portland's Bureau of Planning and Sustainability. He focuses on all aspects of a sustainable food system including land use planning, food security, economic development, purchasing, composting and energy. Sara is the Sustainability Coordinator at Multnomah County's Office of Sustainability and Alex is a Senior Sustainability Analyst at Clackamas County Sustainability and Solid Waste.

People who lived through a major war or the Great Depression waste less than half as much food as younger generations. Families in Southeast Asia waste about one-tenth of what an American family does.

Our modern food industry, so focused on efficiency and output, has radically changed how we relate to what we put on our plate (and how much of it we ultimately scrape back off, uneaten). That the modern food industry has made food so affordable and convenient has made it easier than ever for people in advanced nations to fill their stomachs. However, this cheapening of food stresses calories over nutrition, quantity over quality, and makes it easier for us to waste food.

Meanwhile, most of us are greatly disconnected from the production of our food. From 1950 to 2008, the percentage of people in the U.S. living on farms fell from 25 percent to just 2 percent, and those living in urban areas grew from 29 percent to 82 percent.

Solving the problem of food waste will require systemic change involving people, businesses and governments. But the good news is that there are easy steps we can take on a personal level that benefit our wallets, our families, our communities and the planet. The biggest environmental impacts we make as consumers have to do with our food choices and how much food waste we generate.

This chapter will focus on specific tools, resources and techniques that will help reduce food waste at home. These strategies have three goals:

- 1. Buy the right amount.**
- 2. Keep what is bought at its best.**
- 3. Use what is bought.**

Even those with the best habits sometimes forget about the leftovers at the back of the fridge. But by focusing on simple, practical ways to reduce food waste, we can take note of how easy it is to make a big difference!



THE FOOD WASTE PROBLEM

The amount of food we waste is alarming. A recent study by the ReFED, a national nonprofit dedicated to ending food loss and waste, estimates that in the U.S. approximately 80 million tons of food, about 40 percent of all food produced, is wasted every year. In 2021, wasted food cost the country \$310 billion. This also represents roughly a quarter of the average food budget, which is like purchasing four bags full of groceries and then leaving one at the store every time!

Of course, when food goes uneaten, the resources used to produce it go to waste as well. Four percent of all processed petroleum goes toward food that is ultimately wasted, as does a whopping 25 percent of the fresh water we use. Wasted food also leads to negative environmental impacts. When food decomposes in a landfill, it releases methane, a greenhouse gas 28 times more damaging to the atmosphere than carbon dioxide. Landfills are the U.S.'s largest single source of methane emissions, with 25 percent of our total methane emissions coming from food rotting in landfills. These methane emissions represent 56 percent of our non-CO₂ emissions. If our uneaten food were considered a country, it would rank third in greenhouse gas emissions, behind the U.S. and China.

Meanwhile, Americans waste 1,250 calories per person per day. With one in six people in our country unsure where their next meal will come from, our current level of food waste is both a tragedy and an opportunity.



Happily there are many simple actions that you can take to prevent food waste and people are showing a keen interest in taking the following no-nonsense actions.

Grocery lists can, of course, simply be written on the back of an envelope. You can also go online to find several premade grocery lists. Or try mobile APPs like Out of Milk or Grocery IQ for your meal planning and shopping lists.



BUY THE RIGHT AMOUNT

Plan ahead

With a little planning, you can purchase exactly what you need for the week. In preparation for your shopping trip:

- **Look over your calendar for the week.** About how many meals do you plan to eat at home? How many meals will you be preparing for work or the kids' school lunches? Do you have plans to eat out?
- **Go shopping in your own cupboards and fridge first.** Is there anything that needs to be used soon, before it goes bad? Did you accidentally buy too much the last time you went shopping? Take note of what you already have in stock to ensure that you buy only what you need.
- **Make a list.** Identify the meals that you will be eating in the coming days. Incorporate items that you already have at home and need to use. Which ingredients do you need to pick up that you do not already have?
- **Have a snack before you go shopping.** We've all heard the saying, "Your eyes are bigger than your stomach," and there is some truth to this. We're hardwired to worry about having enough food, and everything looks good when we're hungry! Minimize temptation by shopping on a full stomach — or at least not on a growling one.
- **Plan to get your food home promptly.** Food will stay fresh longer when it is stored immediately after getting home.

As you shop:

- **Stick to the list!** Remind yourself that this list was made for a reason (ahem, many reasons!) and resist spontaneous purchases. After all, you can't waste what you don't buy in the first place.
- **Consider these in-store strategies.** If you are in a grocery store, there are a few easy ways to help keep your shopping trip focused and save you money:
 - **Shop the perimeter.** There, you'll find the freshest items with the highest nutrient-density.
 - **Shop for produce last.** This action will prevent the food from being crushed in your shopping cart.
 - **Consider purchasing ugly produce.** Cosmetically-challenged produce is often discounted and can help shift the way our society views food waste. Purchasing ugly produce can help save money and prevent an enormous amount of food waste. If your grocery store does not yet have an official area for ugly produce, speak to the produce manager about the benefits and ask them to consider creating one.

Shopping in season

Eating seasonally is an often overlooked strategy to reduce food waste. Seasonal foods have a longer shelf life in your home, because they do not suffer the temperature fluctuations inherent in transport from a different climate. Some foods are stored in warehouses so that they can be distributed year round, which also reduces the time they stay fresh once they get to your home. The personal benefit is that eating locally, seasonal food provides more flavor and nutrients. You can find perfect examples of seasonal produce at your local farmer's market or produce section of your grocery store.

Bulk shopping

It is easy to get exactly the number of apples you need for the week in the produce department. But why do hotdogs come in a six-pack while their buns come in an eight-pack? It is worth a second look in your grocery store to see if you have options to purchase products that are not prepackaged.

Ask your grocer if you can purchase just one stalk of celery for the soup you are making. You can also go to the bakery and butcher to order exactly the amount of bread and meats that you need. Most of the time these options cost about the same or a little bit more per item. But if you end up throwing away a quarter of what you purchase because the package was larger than you needed, the cost savings becomes clear.

At many stores, you can enjoy the benefits of the bulk bins for pastas, beans, nuts and seeds, nut butters, flour, sweeteners, chocolate, spices, teas, and more. The cost of items in this section is up to 89 percent less than if you were to buy them prepackaged. Purchasing from this section also enables you to try out new foods without getting stuck with a large amount if you don't like it.

Start or join a food-buying club

A food-buying club is a way for a group of people to join together and purchase bulk foods directly from vendors. Some benefits of being a part of or starting a food buying club include access to quality, organic products at significantly lower prices; connecting with fellow community members, small businesses, and farmers; and reducing carbon emissions by receiving one order as a group rather than everyone purchasing individually. Another option is to share food with family and friends.

The Oregon Farmers Markets Association lists some of the benefits of buying food at farmers markets, including:

- Food is freshly harvested and at its peak in flavor and nutrition.
- Your purchases support your local farmers and the local economy.
- You get to see a variety of food items that are special to your region and ask the farmers questions about their growing methods, favorite recipes, and more.
- Many farmers markets may offer lesser known fruits and vegetables that are not typically available at grocery stores. You may find a new favorite food that you never knew existed!

Farmers who sell at markets generally operate smaller-scale farms that employ practices that generate less food waste.

RESOURCE

Find out what is in season during any time of year by using Sustainable Table's seasonal food guide (available online).

RESOURCE

*You can learn more about food buying clubs by consulting Small Footprint Family's **Why You Should Start a Food Buying Club This Year** (available online).*

KEEP FOOD AT ITS BEST



Getting the right amount of food home is one big step in stopping food waste. Ensuring that food doesn't go bad before we eat it is another. Perishable food is particularly at risk of being wasted. Proper food storage is essential to ensure that your food stays fresh and lasts as long as possible. Here are some tools to help you better understand your perishables.

Expiration dates

Approximately nine out of ten of Americans throw food away because its label says it is at or past its expiration date, even when the food itself is perfectly fine. Research done in the United Kingdom by the Waste and Resources Action Programme (WRAP) shows that 45 to 49 percent of consumers misunderstand the meaning of date labels, resulting in an enormous amount of prematurely discarded food. In fact, WRAP estimates that up to 20 percent of household food waste is directly linked to expiration date confusion.

The Food and Drug Administration (FDA) does not regulate expiration dates, with the exception of baby formula. The dates we see on food packaging are set by the companies that produce our food, and many manufacturers display short time periods that denote when their products are at their peak. Many foods will stay good for days, or even weeks, after the date on the package.

Common date definitions (USDA)

- **Sell-By date.** This date tells the retailer how long to display the product for sale.
- **Best if Used By date.** This date is recommended to enjoy the best flavor or quality of the food. This date does not indicate safety of the food's consumption.
- **Use-By date.** Determined by the manufacturer, this is the last recommended date for the use of the product while at its peak quality.

The particular phrase used on the container ("use by," "best before," "sell by," or "enjoy by") is up to the manufacturer. Some containers include a date but no phrase, leaving consumers to wonder what it references.

However, there are several foods where it does make sense to heed expiration dates due to a high risk of *Listeria monocytogenes*, a dangerous pathogen that can lead to food poisoning. These foods include deli meats, unpasteurized cheeses, smoked seafood, and any pre-made sandwiches with these ingredients.

Alternatives to expiration dates

Happily, since expiration dates are not the best tool to identify safe food, there are some good sources of information to help you decide if your food can still be eaten. The website **StillTasty** calls itself the *ultimate shelf life guide*. Its easy search navigation allows you to enter the type of food and conditions under which it has been stored to determine if it is safe to eat. The USDA also provides a simple chart for refrigerator home storage of fresh and processed sealed products.

It is helpful to let everyone in the household know about StillTasty or print the USDA Cold Storage Chart and put it on the fridge.

Food storage

Whether you know it or not, the shelves and sections in your refrigerator were designed with certain foods in mind. In this section, we will review the areas of the fridge that are ideal for specific foods, the food that works best on the counter or in a dark and cool cabinet, and when you should rely on your freezer.

General food storage best practices include:

- Take perishable food home and refrigerate it immediately. Freeze the food if you can't use it within the times recommended by the resources mentioned above.
- Check labels for storage information. If the food is best stored in a dark place, store it in a dark container, or place a clear container in a dark cabinet or drawer.
- When storing food, use clear containers that allow you to identify the contents or label them.
- Separate very ripe or moldy fruit, as it emits ethylene gas that will quickly spoil other produce.
- Wash produce just before preparation or eating. This will prevent premature spoilage due to moisture.



Below are best practices for storing food in specific areas of your refrigerator and kitchen.

The refrigerator

- Use an *Eat This First* or *Eat Soon* sign to indicate what needs to be used up.
- Look at your refrigerator's temperature indicator (or purchase a thermometer for placement inside). The best temperature for your refrigerator is 40° F. When the refrigerator is too cold, delicate food like salads can freeze. If the temperature is too warm, food can spoil more quickly or pose a health risk.
- The temperature varies throughout your refrigerator. A refrigerator is generally coldest at the bottom and gets warmer at the top, with the warmest area being the door.
- Arrange your food items so that you can easily see everything and keep like foods together. How many times have you opened a new jar of salsa only to find a half-eaten one hidden at the back of the fridge?

The upper shelves

- This is a good space for leftovers, drinks, yogurt, and healthy snacks that you want to keep in plain view.
- Keep a container or basket to hold small tidbits that may get lost and forgotten.



Bacterial growth and enzyme activity are the two things that cause food to spoil. Foods last longer when dried or placed in the freezer because one or more of the following conditions are removed: moisture, warmth and, for some foods, oxygen.

Most refrigerators have produce drawers with humidity settings. Get to know your settings and improve the lifespan of your fruits and vegetables. Information available at eatsmartwasteless.com.



The bottom shelf

- Foods like meat, poultry and fish have a higher safety risk and do best in the coldest area of the fridge. Storing them on a low shelf also reduces the risk of contamination if they leak

Crisper drawers

- This area creates a separate humidity zone from the rest of the refrigerator.
- Adjust the drawers so that you have one high-humidity drawer and one low-humidity drawer.
- High-humidity is best for vegetables, especially those likely to wilt. Foods that depend on water to keep their structure (for example, greens, cucumbers, and carrots) do best here and will stay perky longer.
- Shelf life is lengthened by cold temperatures that slow food's respiration, or *breathing process*. But don't stop the breathing altogether by sealing fruits and vegetables in an airtight bag, as they will rot faster.
- Low humidity is best for fruits and vegetables that rot easily (berries, grapes, mushrooms, peppers and avocados). Since apples, pears and bananas give off ethylene gas as they ripen, it's best to keep them in an area with better air circulation so that the gas isn't trapped. Trapped ethylene speeds up the ripening process of other foods.

Cheese drawer

- Fatty foods, like cheese, often absorb the odors of other foods in the refrigerator. Isolating cheese prevents waste and odor absorption.

The refrigerator door

- The door is the warmest part of the refrigerator and is exposed to the room's temperature every time it is opened.
- Condiments can store well here.
- Do not store anything perishable in the door, including eggs (even if there is a compartment for them).

The freezer

- Freeze food that you won't be able to eat before its expiration date.
- Perishable products kept frozen continuously are safe indefinitely.

The counter, cabinet or drawer








- Store onions, garlic, potatoes, mangos, papayas and pineapples in a cool, dark place.






Tips for individual foods






Now that you have a general understanding of how each area in the refrigerator serves a purpose, here is a list of common foods and the locations where they store best. This list will be helpful to have with you when you are tabling and helping people troubleshoot food that goes bad in their house.

RESOURCE

Waste-Free Kitchen Handbook by Dana Gunders lists more foods and their detailed storage instructions.

Food	Refrigerator	At freshest	Storage tips	Freezer
Apple 	Yes, low-humidity drawer.	Up to 6 weeks in refrigerator.	Wash only before using.	Raw or cooked.
Asparagus	Yes.	3-5 days.	Upright in bowl with 1" of water on top refrigerator shelf. Or, wrap ends in moist towel in high-humidity drawer.	Blanch, immerse in ice water, dry, place on baking sheet and freeze. When frozen, move to a container.
Avocado 	Yes, after it's ripe.	Whole, after ripe, 2-5 days in refrigerator.	Counter until ripe, then in refrigerator.	Peel and puree.
Banana 	Optional after ripe.	Less ripe: 5-7 days. Ripe: 1-2 days.	Counter at room temperature.	Peel and store in airtight container.
Beans, Canned or Cooked	Yes, after opened or cooked.	Can in pantry: several years. Cooked in refrigerator: 3-5 days. Freezer: up to 3 months.	Cooked: in their cooking liquid or water in airtight container.	Sealed container with their cooking liquid or water.
Berries 	Yes.	Rasp-, straw- and blackberries: 2-3 days. Blueberries: 10 days.	Wash only before using.	Remove any stems, rinse, and dry.
Bread 	No.	Counter: a few days. Freezer: 6 months.	Room temperature in bread box or paper bag.	Wrap tight in airtight wrapping. Sprinkle stale bread with a little water and place in oven to warm.
Broccoli 	Yes.	5-7 days.	Wash only before using. Breathable bag in high-humidity drawer.	Wash, separate into florets, blanch, immerse in ice water, and drain until dry. Freeze on baking sheet and then transfer to a container.
Butter	Yes.	Opened: 3 weeks. Unopened: 2 months.	Refrigerator in original packaging and in cooler area (near back).	In original carton in zip top freezer bag.
Carrots 	Yes.	2 weeks.	Wash only before using. Breathable bag in high-humidity drawer. Cut carrots in 1" of water.	Wash, blanch, cool, chop, and pack in airtight container.

Food	Refrigerator	At freshest	Storage tips	Freezer
Celery 	Yes.	2 weeks.	Standing in jar of water or in open plastic bag in high-humidity drawer.	Slice, blanch, immerse in ice water, drain until dry, place in container.
Citrus 	Yes.	Counter: 4-5 days. Refrigerator: 3-8 weeks.	Loose in low-humidity drawer.	Some can become bitter when frozen.
Cheese 	Yes.	Hard cheese: 1-10 months. Soft cheese: 1-4 weeks.	Store in refrigerator drawer. Loosely wrap in wax or parchment paper to allow it to breathe.	Hard: grate or cube before freezing. Soft: cube before freezing
Corn on the cob	Yes.	In husk: 2-3 days. Dehusked: 1-2 days.	Eat as soon as possible. Store in husks in middle or upper shelf, wrapped in damp cloth in container.	Remove husks. On the cob, blanch 7 minutes. If freezing kernels, blanch on cob for 4 minutes then cut off kernels. Place in container.
Cucumber	Yes.	1 week.	Wrap in a damp cloth in high-humidity drawer.	Not recommended.
Garlic, Shallots	Unpeeled: no. Peeled: yes.	Unpeeled: several weeks to several months. Peeled: several weeks.	Unpeeled in cool, dark, dry place.	Peel or chop and store in container.
Eggs	Yes.	Unopened: 10 days. Opened: 3 days. Frozen: 1 year. Thawed: 7 days.	Lower shelves in original container. Transfer to airtight container to extend life.	Do not freeze in shells. Lightly beaten eggs can be frozen in airtight containers with 1" headspace.
Grapes	Yes.	2 weeks.	Wash only before using. Keep in breathable bag on refrigerator shelf.	Wash, dry, place on baking sheet and freeze. When frozen, move to a container.
Herbs: Basil, Parsley, and Cilantro 	No, leaves will turn black if refrigerated.	2-7 days.	Trim ends and place in glass of 1" of water. Keep on counter at room temperature.	Fill ice cube trays with herbs and water or olive oil (for cooking later). Transfer frozen cubes to container.
Herbs: Chives, Thyme, and Rosemary	Yes.	10-14 days.	Wash only before using. Wrap loosely in plastic/paper towel and place in refrigerator door.	Fill ice cube trays with herbs and water or olive oil (for cooking later). Transfer frozen cubes to container.
Melons 	Yes, after ripe.	Whole: 5-15 days. Cut: 3-5 days.	Whole: in a cool, dark, dry place. Ripe: on shelf in refrigerator. Cut: in airtight container.	Remove rind, cube, place on baking sheet and freeze. When frozen, move to a container.

Food	Refrigerator	At freshest	Storage tips	Freezer
Milk	Yes.	Pasteurized: 1 week beyond sell-by date. Freezer: 3 months. Open carton: 7-10 days.	Not in the door but in the coldest part of the refrigerator.	It may separate if left frozen for long periods. Store in airtight containers leaving 1" headspace.
Onions 	No.	Whole: several months. Cut: 7 days.	Whole: cool, dark, dry place, hanging sacks ideal. Away from potatoes. If cut, store in refrigerator with peel on.	Remove skins and root. Chop and freeze raw.
Pears 	Yes, after ripe.	After ripe: 5 days in the refrigerator.	Wash only before using. Will ripen at room temperature.	Pears freeze best when cooked in sugar syrup.
Potatoes 	No.	New: 2-3 days. Mature: 2-3 weeks.	Wash only before using. Cool, dark, dry place with ventilation.	Not recommended.
Apricots, Peaches, Nectarines, Cherries, Plums, Pluots 	Yes, after ripe.	After ripe: 3-7 days in the refrigerator.	Wash only before using. Unripe: store at room temperature in dark. Ripe: low-humidity drawer in open paper bag.	Freeze raw (whole or in slices) or cooked.
Pineapple, Papaya, Mango	Yes, after ripe.	Whole: 2-3 days past ripe on counter; 5-7 days in refrigerator.	Unripe: store whole on counter at room temperature. Ripe: loose on refrigerator shelf or in low-humidity drawer.	Peel and cut into chunks, place on baking sheet and freeze. When frozen, move to a container.
Tofu	Yes.	10 days.	Original package until opened, then submerged in water in container. Change water daily.	In original container then thaw in refrigerator and squeeze out moisture.
Tomatoes 	No, unless cut.	Whole/Ripe: up to 3 days at room temperature. Cut: 2-3 days in refrigerator.	Wash only before using. Whole: on counter, away from sun, stem up. Cut: in refrigerator.	Freeze raw or cooked in freezer bags.



If you wind up throwing away food at home because you went out to eat instead, the cost of that restaurant meal just became higher than you originally thought.

EAT WHAT YOU ALREADY HAVE

Efficient food preparation



How many times have you felt too tired or busy to prepare a meal and then resorted to ordering food for delivery or takeout? When this happens, the food you may already have at home can wind up pushed to the back of your refrigerator and be forgotten. Over time, the small amounts of food that are bypassed for a quicker, more convenient option can add up to big waste.

To help save you time in the long run, consider the following:

- **Cook once and eat twice.** Make a larger quantity and portion off some to be eaten for the next day's lunch.
- **Measure food before cooking.** Rice, pasta and beans are among the many dry foods that are hard to judge proper portions, because they expand when they cook. Use portion guides and measure food to avoid cooking more than you need. Once cooked, storage options are dramatically reduced with these foods.
- **Create one-pot meals.** Use only one pot to create a meal. This method results in fewer dirty dishes, and the food created with this method generally freezes and reheats well. Recipes can be easily found online.
- **Prepare ahead of time.** Chop large amounts of produce ahead of time. If you have salads regularly, you can have pre-diced ingredients like onions, carrots, and peppers on hand, ready to toss into a salad at any time. You'll also reduce the time spent cleaning your cutting board and knives since you only need to chop once.
- **Make friends with the peels.** Don't bother peeling all of your produce. Carrots, beets, and potatoes roast great with the skin on and provide nutrients that would otherwise be lost if removed.

Stretching your food out

You're already on your way to thinking more mindfully about what you bring into your kitchen, but what about dealing with food that is on its way out? Instead of letting your vegetables further wilt, try out some of the following suggestions to keep your food from going into the compost bin:

- **Unused vegetables** can be steamed, blended, and then frozen in an ice cube tray to use in sauces and soups at a later date. Fruits can be made into pies and smoothies.
- **Freeze bits of meals.** Saving small amounts of excess gravy, a rub, marinade, herb blend, stuffing, or vegetables can provide a savory mix to purée for a sauce, a little flavor jolt, or even a starter to your next meal. Experiment with mixing flavors, or recreate a dish from flavors that you already love.
- **Create your own vegetable stock.** If you cook with a lot of fresh produce, save your carrot tops, chard spines, and celery stubs in a designated container for a weekly soup stock pot.

Having the following staples on hand will assist you in using up other foods so they don't go to waste. Customize this list to your own taste, and you can transform your use-it-up meals into masterpieces!

- Grains like rice, pasta, quinoa, couscous
- Oils like olive, sesame, canola, safflower
- Vinegars like cider, balsamic, rice
- Soy sauce, mayonnaise, mustard
- Eggs
- Beans
- Onions, garlic, canned diced tomatoes
- Hero condiments that can improve flavor in a pinch: soup bouillon, dried onions, sundried tomatoes, hot sauce, BBQ sauce, lemon juice, Parmesan cheese, maple syrup, raisins, almonds and pickles.



RESOURCE

*Finding creative recipes online or in cookbooks that utilize foods that are past their prime is easy. You can take a look at The Huffington Post's **Over 30 Recipes to Reduce Kitchen Waste** (available online) and Dana Gunders' book, **Waste Free Kitchen Handbook**.*

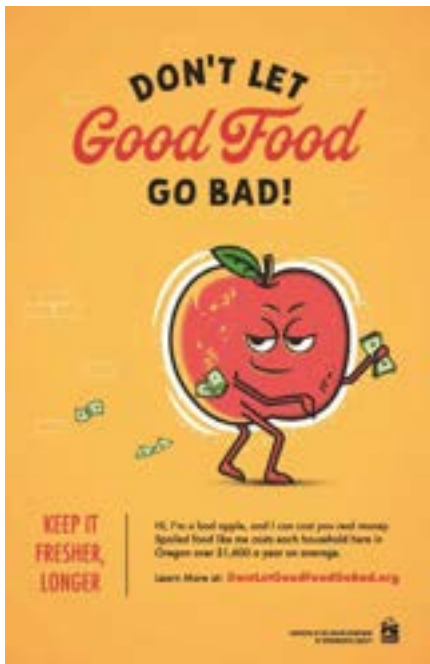
DEEP DIVE

See fellow Master Recyclers using Eat Smart, Waste Less talking points on the Master Recycler YouTube Channel.



Liz Start at
Tigard Farmers' Market

Learn more about the Eat Smart, Waste Less Challenge [online](#).



Visit dontletgoodfoodgobad.org

THE EAT SMART, WASTE LESS CHALLENGE

Master Recyclers can share food waste prevention tips with neighbors, friends and members of the community through the Eat Smart, Waste Less Challenge, an online website compiled by local governments with tools and resources to support wasting less food. The goal is to encourage people to take one small step, like storing fruits and vegetables in ways to keep them fresh longer.

As a Master Recycler, you can help people prevent food waste at home by assisting with a presentation or staffing an information booth for the Eat Smart, Waste Less Challenge. Share your personal connection to food waste, give out tools, co-present or just observe and learn how to give the presentation yourself.

Master Recyclers have the option of checking out the kit from your local jurisdiction to offer a presentation or staff an event in your own community.

DON'T LET GOOD FOOD GO BAD

In 2018, the Oregon Department of Environmental Quality (DEQ) Materials Management Section set out to create a research-driven campaign with messaging and materials to inspire Oregonians to waste less food. As part of this project, DEQ sponsored qualitative and quantitative research focused on consumer attitudes and practices related to food waste, and an in-depth analysis to assess how much and what types of food Oregonians waste and why.

The study found that 50 percent of Oregonians believe taking steps to reduce food waste is important, but are not currently taking steps themselves. The study also found Oregonians are complacent about wasting food, but motivated by saving money. Thus, talking about ways people can save money by wasting less food is more likely to inspire change than talking about how food waste is a problem.

To support this education, DEQ launched the Don't Let Good Food Go Bad campaign, which uses the study's findings to inspire Oregonians to save money by saving food. The campaign includes videos and resources you can share on social media and at events.



MORE WAYS TO MAKE FOOD LAST

Considering the growing interest in reducing food waste and saving money, it's no wonder that sales of home canning supplies increased by 35 percent between 2008 and 2011. The COVID-19 Pandemic saw books on canning increase by 175 percent. People are becoming more aware of the health and cost benefits to stocking their pantries with nutritious foods, that were purchased and preserved at their peak.

Home preservation techniques may seem like a thing of the past to some, but they are a popular topic for classes and workshops at continuing-education organizations and stores. Some of the most common food preservation techniques today include canning and pickling, dehydrating, and root cellars.

Canning and pickling. Involves sterilizing a jar and lid, cooking something, putting it in the jar, and then boiling the jar. Foods can be canned in water, juice, syrup, or their own liquids, depending on the food. Some foods do not need to be cooked at all and can simply be added to a sugar syrup, juice, or vinegar brine. Refer to the Existing Resources list (below) to learn about some local organizations offering food preservation classes.

Dehydrating. Also called drying, this method includes an electrical appliance with heat, a fan, and vents for air circulation. Moisture is removed from the food in order to make it last longer. While some foods can be eaten in their water-less state (such as fruit and vegetable leathers and dried fruits), others should be rehydrated before use (such as mushrooms).

Root cellars. Many gardeners take advantage of this method when they are looking to store relatively large quantities of food to last throughout the winter. Some fruits and veggies store best at 50° F, above the temperature of your refrigerator, but colder than room temperature. Foods that do well in root cellars include root vegetables like potatoes, carrots, and onions, as well as squash, apples and pears.

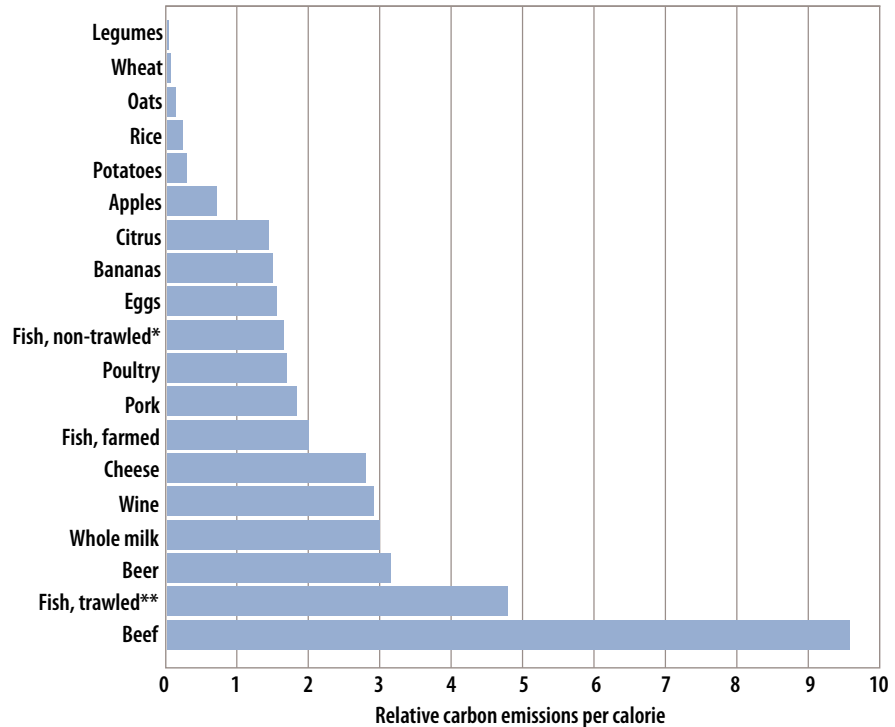
DEEP DIVE

Want to know how your diet adds up? Visit *Bon Appétit's Eat Low Carbon website*.

FOOD CHOICE

When it comes to carbon emissions, what we eat is more important than where it is grown. Buying locally can reduce the environmental impacts of transportation, but they are generally small when compared to the energy and resources that went into raising or growing our food. In the case of meat, buying locally reduces the related energy costs of that food by 1 to 2 percent; for produce, it's about 11 percent.

FOOD CHOICE IS A KEY FACTOR IN CARBON EMISSIONS



Carbon emissions from food choice, by calorie. Prepared by: Accuardi, Zachary (2016, forthcoming).
 *e.g., wild salmon **e.g., red snapper

Moving toward a diet rich in fruits, vegetables and grains is one of the most environmentally impactful things we can do because of all the resources and carbon emissions that are associated with raising animals. Yes, talk of dietary choices can be sensitive, but as mentioned before, the biggest environmental impacts we make as consumers have to do with our food choices and how much food waste we generate. Substituting some meat-based meals with plant-based meals every week has major environmental benefits. When combined with our efforts to use up everything we have and to make our food last longer, we can drastically reduce our personal carbon footprint.

EXISTING RESOURCES

All of the resources listed below have websites that you can consult for more information about particular food topics.

Grocery Shopping and Meal Planning

- **Seasonal Food Guide** – through The Sustainable Table.
- **Food.com** – Find recipes. Plan Meals. Score Deals. Features: Free web-based tool, sales/discounts by store location, recipes, meal planner and shopping lists.
- **Cozi** – Great for family meal planning. Features: Free web-based tool, shopping list, meal planner and recipe storage.
- **Love Food, Hate Waste** – Great for meal planning and making the most of leftovers. Features: portion planner, a recipe ‘blender’ hints and tips, meal planner and shopping list.
- **Out of Milk** – Create shopping lists and share with others in real-time. Features: Free web-based tool, shopping list, to-do list, pantry list and barcode scanner.
- **Shopping List** – Simply google shopping list and find a wide range of options.

Farmer's Market Locators

- **Oregon Farmer’s Market Association**

Food Storage

- **Still Tasty** – Your Ultimate Shelf Life Guide.

Food Preservation Classes

- **OSU Extension**

Food donation

- **Oregon Food Bank**
- **Portland Food Pantries**
- **Urban Gleaners**

Online Tools

- **Meatless Monday**
- **Wasted Food** – A blog by Jonathan Bloom.
- **Environmental Working Group Food Scores** – Find food scores for nutritional value, ingredients of concern, and degree of processing. Features a searchable database with more than 80,000 products, 5,000 ingredients and 1,500 brands.
- **SavetheFood.com**

Movies, Videos, and Documentaries

- **Just Eat It: A Food Waste Story**
- **Wasted! The Story of Food Waste**
- **The Extraordinary Life and Times of Strawberry**



CONCLUSION

Household food waste is not inevitable. Much of it happens because of habits we have learned. So by learning better habits — specifically, how to store food smarter at home and how to prioritize quality, healthy food when we shop — we can make positive impacts without sacrificing convenience.

Despite changes in how most of our food is grown or raised, the food we eat remains one of our most immediate, direct connections to the Earth. Food also connects us to other people: we gather around the dinner table with our family and friends, and we prepare special meals for celebrations and holidays. On a larger level, we cannot understand a culture without knowing the food that the people eat. It is as defining a cultural characteristic as language, art and history, and it undoubtedly plays a part in our personal identities. Indeed, what we eat says a lot about who we are and how we live. And so does how we take care of the food we bring home.

The ideas here for reducing food waste are plainly positive, building off the new food movement. We do not need to give up anything when we become proactive about food waste. We want to eat great food, celebrate it, grow some of it ourselves, bring back the family dinner table, provide great school lunches, recognize the labor of farmers and farmworkers, and create a system where food is treasured, not wasted. Being mindful about our food allows us to rediscover its link to our environmental and personal health and its capacity to strengthen our connections to one another and to our world.

CHAPTER 15

ELECTRONICS MATERIALS MANAGEMENT

INTRODUCTION

From giving rhythm to the pulse of a person's heart to connecting remote communities around the world, **electronics** are increasingly an essential aspect of everyday life.



TERM

Electronics are defined as any device (television, radio, computer, appliance etc.) that operates with an electrical current and often has small working parts such as microchips.

Special attention should be paid to electronics when talking about materials management, in part, simply because they are so prevalent. Electronics are also important because their environmental and social impacts are uniquely troubling all along the materials life cycle.

This chapter will demonstrate the social and environmental impacts related to electronics as well as explore choices that we can make at home and at work to reduce these negative impacts. The chapter will also explore various policies and programs (proposed and existing) focused on reducing the negative impacts of electronics.

LIFE CYCLE OF ELECTRONICS

Electronics require a wide range of raw materials that must be extracted from the earth. Barium, beryllium, cadmium, copper, gold, lead, mercury, nickel, and oil and natural gas are all commonly used in producing electronics. These materials carry with them a wide range of problems at each stage of the life cycle.

Environmental and health impacts of mining and manufacturing electronics

The mining of raw materials for electronic products contributes to increased respiratory problems for workers, such as silicosis, tuberculosis, bronchitis and lung cancer. Mining pollutes the water of surrounding communities through cyanide-contaminated waste ore and other mine wastes including toxic metals and acids, which often get released into lakes, streams and oceans, killing fish and contaminating drinking water. This water pollution is especially concentrated in communities rich in these minerals and/or without the power to control how they are managed.

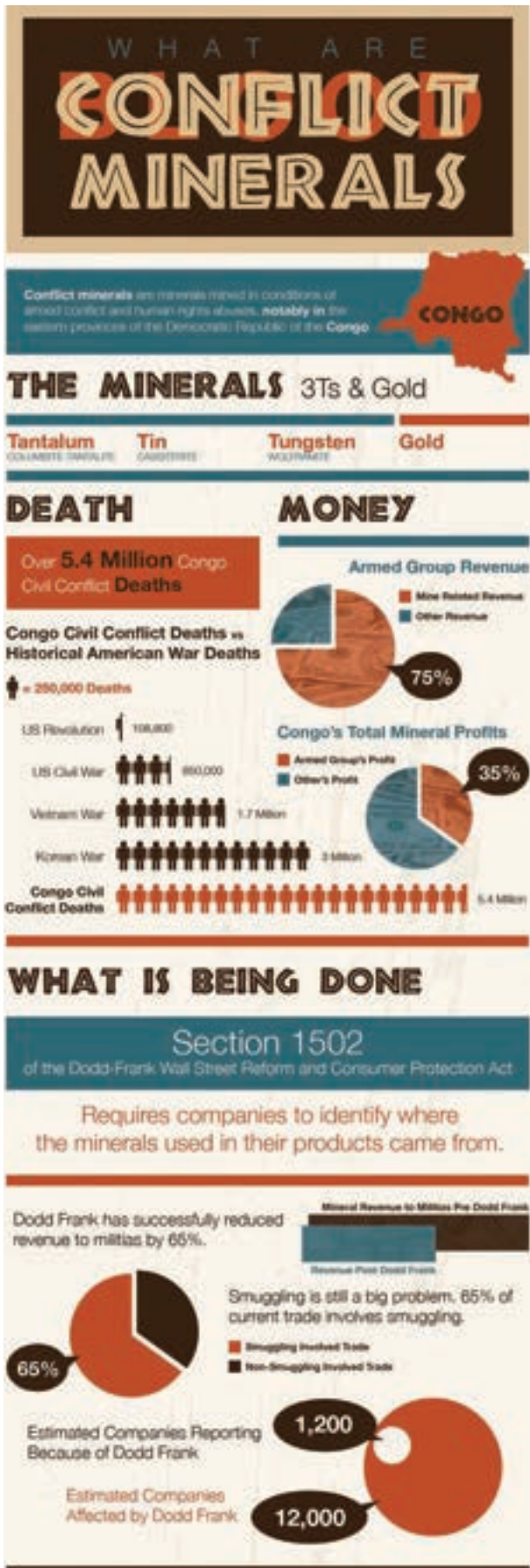
The United Nations estimated, for instance, that by 2008, ninety percent of El Salvador's surface water was contaminated by gold mining pollution (UNICEF 2010). The Acelhuate River is so contaminated with heavy metals and industrial waste that it is considered a biohazard.

Many of these toxic materials are delivered in a raw state to manufacturing facilities in the United States and abroad. Workers in these settings experience the same types of illnesses as those who are exposed in the mines. Even workers in the United States will, for instance, use cadmium, a known carcinogen as a solder for circuit boards and other metal parts. The EPA regulates U.S. business and has established an allowable level of the cadmium to be released in the drinking water, soil and air. The same cannot be said for factories around the world.

Conflict and minerals

The intense need for inexpensive raw materials for electronics creates social conflict in communities affected by polluting mines. Communities can become displaced when their waterways are poisoned and also when mining companies need to expand or build infrastructure to move the extracted materials. When people try to protest in the countries that have repressive governments, they experience imprisonment, murder and physical removal.

What's perhaps even more troubling than social problems caused directly by mining is how the income from mining is often used to buy weapons that then support repressive governments, fuel wars and arm violent militia groups. This phenomenon has been coined *conflict minerals*.



Source: www.sourceintelligence.com/what-are-conflict-minerals/

In the past 15 years the mining of metals for electronic products has been fueling a civil war in the Democratic Republic of Congo (DRC) that has resulted in the loss of more than five million lives and involved human rights violations including mass murder and rape. The government and rebel armies both finance their operations through mining tin, tantalum and tungsten (known as the 3 Ts), as well as gold, for use in our cell phones, laptops, MP3 players and game devices.

Use phase

The impacts of the use phase are often overlooked as we tend to focus more on extraction and production as well as downstream activities such as landfilling and recovery. Electronics require energy for operation, so the use phase has significant ongoing impacts.

Planned obsolescence

The use phase is, however, often unnaturally shortened due to what is known as planned obsolescence. You have encountered planned obsolescence if you have ever updated your phone or computer, only to find that afterward the hardware no longer works well with the new software. Companies frequently make it so that the latest version of software is not compatible with earlier versions. While electronics is a rapidly innovating field, companies often have a vested interest in shortening the useful lifespan of a device and forcing consumers to buy a new one before it has actually worn out.

TERM

Planned obsolescence: An intentional policy by manufacturers to plan or design a product so that it loses its value, becomes outdated or out of fashion, and/or ceases to work after an expected period of time or use in order to increase profits.

RESOURCE

For more on the Electronics Disposal Ban visit the Oregon E-Cycles webpage.

E-waste

E-waste is discarded electronics, and it includes materials destined for reuse, resale, salvage, recycling or disposal. Due to the high number of toxic chemicals involved, as well as the high value of materials embodied in these discards, disposal and recovery of e-waste takes on more significance than most other waste streams.

Toxics and e-waste

Since certain components of electronic devices may be considered hazardous due to heavy metal or other potentially dangerous elements, the end-of-life handling of some electronics discards is regulated by either federal (Resource Conservation and Recovery Act--RCRA) or state (Department of Environmental Quality) hazardous waste laws, or both. Managing these special materials is costly with the burden falling mostly on the consumer and local governments.

Oregon regulations regarding the proper management of Cathode Ray Tubes (CRT), found in older technologies for computer monitors and televisions, took effect in 2010. Oregon law now prohibits computers, laptops, monitors, and TV sets regardless of display style or technology (CRT or flat screen display) from being landfilled. Violators of this ban could face stiff fines of up to \$500 for each prohibited item disposed of improperly.

Problems with overseas recovery

Recovery of materials that go into electronics is an important way to interrupt the need for extraction of minerals to make new electronics. Recycling and reuse save energy in the manufacturing process. Extracting precious metals can also offer great economic benefits.

Unfortunately, because of the extra burden of managing the hazardous materials in e-waste, much of the recovery has taken place in countries where wages are extremely low and working conditions dangerous. The EPA estimates that in 2010 as much as 50-80 percent of e-waste recycling and reuse was exported.

The Basel Action Network (BAN) is a non-profit organization that exposes what they term, the “devastating impacts” of this toxic international trade. BAN offers education programs like their films “Exporting Harm” and “Digital Dump” to expose the impacts of e-waste that arrives every year in China and Africa. In these films, we follow the brokers to small towns where families are dismantling electronics with bare hands and rudimentary tools, melting heavy metals in their front yards and burning piles of e-waste plastics.



The Digital Dump, Illegal Electronics Waste Trade in Nigeria, a documentary

Along with education, BAN organizes the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The Convention gathered signatory nations for a treaty that was adopted in Basel, Switzerland on 22 March 1989. The Convention was initiated in response to numerous international scandals regarding hazardous waste trafficking that began in the late 1980s. To date, the Federal government of the United States is not a signatory to this treaty.

Digital safety

One area that sometimes gets overlooked when discussing e-waste is digital safety. From your phone to your personal computer, most households, businesses, non-profits and public agencies rely on their electronics to store sensitive data such as names, addresses, social security numbers, correspondence, medical or mental health records. Just because an electronic device is deemed replaceable does not mean that the data on it is not still easily accessible. Information security breaches can have major legal and financial ramifications.

According to TechSoup.org, there are two best choices to eradicate data. Before donation, recycling or disposal, one can either physically destroy the hard drive or wipe the data with software designed to completely wipe the data clean. The first option is the best when the hard drive is no longer reusable. Some might be tempted to simply reformat a hard drive or delete files. Techsoup.org recommends avoiding these options as they do not thoroughly destroy the data.

Better yet, there are many software programs online that will help destroy the data before the machine is out of your hands. Disk-wiping software works by overwriting the *ones and zeros*, that make up your data with random information (new *ones and zeros*).

Consumers should ask about the policies of depots for recycling and reuse to understand how they might destroy the data.

DEEP DIVE

Learn more about the Basel Network on their website.

Exporting Harm and Digital Dump are both videos you can check out in the Master Recycler Library or watch on YouTube.

TAKING CONTROL OF THE ELECTRONICS PROBLEM

The ubiquitous nature of electronics, the constant need for the most up-to-date technology and their devastating social and environmental impacts can create a feeling of helplessness for the concerned consumer. There are, however, choices that we can make at home and at work to strike a better balance. There are also important policies we need to understand, support and strengthen if we want to address the problem at the global level.



Consumer choice

There are a number of efforts to empower the consumer to better understand the problems related to electronics as well as weigh the impacts of differing products.

EPEAT

EPEAT (Electronic Product Environmental Assessment Tool) is a comprehensive global environmental rating system that helps purchasers identify greener computers and other electronics.

The EPEAT system was developed and is managed through an open process involving representatives from all stakeholder groups. Manufacturing, environmental advocacy, academic, trade association, government and recycling entities all actively participate.

Products are measured against both required and optional criteria. A product must meet all of the required criteria in its category to be added to the registry. It is then rated Bronze, Silver or Gold depending on how many of the optional criteria it meets. Bronze-rated products meet all required criteria, Silver-rated products meet all required criteria and at least 50 percent of the optional criteria, and Gold-rated products meet all required criteria and at least 75 percent of the optional criteria.

EPEAT product criteria include several categories of environmental attributes and cover the full life cycle of electronic products. *The PC and Displays, Imaging Equipment, and Televisions standards address:*

- Reduction/elimination of environmentally sensitive materials
- Material selection
- Design for end of life
- Product longevity/life extension
- Energy conservation
- End-of-life management
- Corporate performance
- Packaging
- Consumables (unique to Imaging Equipment standard)
- Indoor Air Quality (unique to Imaging Equipment standard)

Conflict Minerals

The Enough Project works to raise awareness of conflict minerals and offer resources to help colleges, cities and individual consumers minimize the chances that electronics that they purchase are made with conflict minerals.

ENERGY STAR

As previously mentioned, one of the most important impact stages in the life cycle of electronics is the use phase. In short, it takes energy to run electronics. So it is important that consumers think about the energy efficiency of products when making purchases. Happily, there is a well-established tool to help consumers in this area.

ENERGY STAR is a U.S. Environmental Protection Agency voluntary program that helps businesses and individuals save money and protect our climate through superior energy efficiency. Now in its 20th year, the ENERGY STAR program has boosted the adoption of energy efficient products, practices and services through partnerships, objective measurement tools and consumer education.

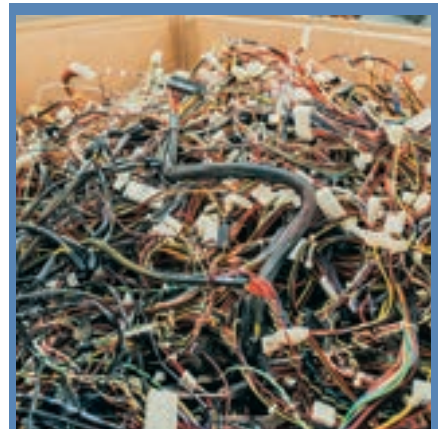
When consumers are done using high energy use products, they should also put careful consideration into whether it is better to recycle the product rather than offer it for donation and reuse where it will continue to use high levels of energy.

E-waste certification programs

While EPEAT helps consumers think about better purchasing options, and Energy Star ensures that the use phase is efficient, there are also programs designed to inform consumers about choices for the ultimate disposal of unwanted electronics.

According to the EPA, consumers can effectively reduce environmental and human health impacts from improper recycling by choosing electronics recyclers who demonstrate to an accredited, independent third-party auditor that they meet specific standards to safely recycle and manage electronics. Currently two accredited certification standards exist on a national level: the Responsible Recycling (“R2”) Standard for Electronics Recyclers and e-Stewards®.

Both certification programs share common elements that ensure responsible recycling or reuse of electronics. These programs advance best management practices and offer a way to assess the environmental, worker health, and security practices of entities managing used electronics. Specifically, these certification programs are based on strong environmental standards which maximize reuse and recycling, minimize impacts on human health or the environment, promote safe management of materials by downstream handlers, and audit the destruction of all data on used electronics.



DEEP DIVE

You can learn more about **e-Stewards** on their website and you can learn more about the **R2 Standard** on the website of Sustainable Electronics Recycling International.



Certified electronics recyclers have demonstrated through periodic audits and other means that they continually meet specific high environmental standards and safely manage used electronics. Once certified, the recycler is held to the particular standard by continual oversight by the independent accredited certifying body.



As a consumer, it is not necessarily important to understand the difference between R2 and eStewards certification. eStewards certification costs more and covers more, but R2 certainly shows commitment to sustainability. Some processing companies find value in having both certifications.

Oregon E-Cycles

Oregon E-Cycles is a program managed by the Oregon DEQ that enforces both the management of e-waste and also producer responsibility.

The program is a producer responsibility program in that it ensures that anyone who sells a new computer in Oregon participates in the costs of the resulting e-waste. DEQ also created specific environmental criteria for each of the participants in the Oregon E-Cycles program including the collectors, the transporters, the processors and the manufacturers. When the public brings electronics into an authorized collector, they can know that strict environmental handling procedures are followed at all levels.

Anyone in Oregon can take seven or fewer computers (desktops, laptops and tablets), monitors, TV's and printers at a time to participating Oregon E-Cycles collection sites for free recycling. Computer peripherals (keyboards and mice) are also accepted free of charge. Other types of electronics are currently not included in this program. However, many of the collection sites also accept other electronics.



DEQ's Monster in your Closet campaign encourages people to properly dispose of e-waste lurking in their homes.

U-waste

There are many products that have similar, if not the exact same, end-of-life problems as e-waste. Objects like fluorescent bulbs, batteries and ballasts may not be electronic, but they have toxics and are expensive to landfill or recover. A growing number of e-waste processors are finding innovative and safe ways to also manage these discards. They have begun to use the term u-waste (or Universal Waste) to describe them. Households should take these products to one of the Metro hazardous collection sites, and businesses can contact Metro's Recycling Information Center (503-234-3000) to identify a local company that can accept u-Waste for recovery or proper disposal.

Three ways to tackle planned obsolescence in electronics

Fortunately, consumers are not entirely at the whim of planned obsolescence. There are a few strategies that can ensure the longest possible lifespan for your electronic devices.

1. Use Open Source Software

Mainstream software companies such as Apple and Microsoft keep proprietary rights to their software. The exclusive copyright owners license out the use of their software usually with only limited conditions of use.



Often when these companies release a new version of software it triggers a domino effect that renders hardware and accessories obsolete. With a closed software system the only people consumers have to go back to get repairs, tech support and updates are the same people that have a vested interest in your giving up and buying a newer product.

Open source software is a way out of this march to the great digital dump. Open source software is designed by a community of developers who agree to openly share the source code (or internal workings) of the software. To be called open source, software must allow for free redistribution, allow others to modify the software, must work on any platform and needs to not restrict other software from working. The definition of open source is maintained by a non-profit organization called Open Source Initiative. They have a compliance/certification process. However, the main power behind open source is peer review. The open source community is constantly tinkering, creating new add-ons, solving problems and then sharing the results. Program developers set up feedback loops so that new ideas can improve the existing programs.

Free Geek in Portland is a great place to learn more about open source. They offer community classes on the operating system called Linux Mint that they install on all of their computers.

TERM

Open Source Software

is computer software that is released under a license in which the copyright holder grants users the rights to use, study, change, and distribute the software and its source code to anyone and for any purpose.

2. Prolong the life of your products

Read up on the best ways to extend the life of your electronics and their batteries. Here is an example of how the EPA suggests making your smart phone work better and last longer. When you make a purchase, ask questions and look up information to learn similar tips for other products.

- Choose your service provider carefully. Many companies sell their own phones which are not always transferable between companies.
- Select a phone with features you need and a style you like so you'll keep it longer.
- Take care of your phone. Use a case, keep out of extreme temperatures and avoid water.
- To extend your phone's battery life, limit location services, reduce brightness, switch to airplane mode when out of range, close unnecessary apps and turn auto updating off.
- Don't worry about overcharging. New smartphones with lithium-ion batteries don't have a problem with partial discharges. In fact, charging a little at a time, instead of draining the battery all the way down, will help preserve your overall battery life.



Learn more in *Shady World of Repair Manuals: Copyrighting for Planned Obsolescence* published in *Wired Magazine* (available online).

3. Fix your electronics

Large electronics manufacturers don't want you to know that it is actually pretty easy to fix a lot of the gadgets we have around us. If you knew that, it would slow you down from buying more of their products. Companies have gone so far as to make it nearly impossible for a consumer to get their hands on an owner's manual which would help them understand how things work and can be fixed. Blocking access to information about products can negatively affect the repair shop economy. One Australian tried to create a website for fellow repair companies that posted the manuals of electronic products. Toshiba sued and won for infringement of copyright.

Despite these roadblocks, many electronics are worth attempting to fix. Here are some resources that may be worth investigating before giving up on a broken electronic device:

iFixit is a global community of people helping each other repair things. Their website includes manuals (either found online or created by iFixit volunteers who take things apart and write manuals about how things work), a forum to ask questions, and a store for tools and parts.

Not up for taking on the task yourself? **RepairPDX.org** organizes free events that bring volunteers who like to fix things together with people who have broken items that need fixing. Experts are on hand to fix items as well as teach participants how to fix their own items. Most events will have people who know how to use a sewing machine and soldering iron. There may also be cobblers.



There are dozens of small businesses in the metro area that repair many types of electronics. It is a common myth that taking electronics to these places costs more than simply buying a new product. While this can sometimes be the case, it is often cheaper. If you weigh the full environmental and social costs of making and discarding electronics, a quick repair is often worth it.



➤ **RESOURCE** ◀

You can learn more on
iFixit's website.

➤ **RESOURCE** ◀

You can learn more on
Free Geek's website.



When asked why businesses should choose to recycle e-waste properly even if it isn't required Jason Kragarud, e-waste processor at Universal Recycling Technologies, says, "Two reasons, well, probably three: 1) peer pressure, i.e., if NIKE leads the charge, other shoe companies will feel they have to follow along, 2) media pressure, i.e., if you get caught sending e-waste to Third World Countries, the media will be all over you, and lastly, 3) it's the right thing to do."



DEEP DIVE

To learn more about proposed legislation and how you can support it in Oregon, visit the Association of Oregon Recyclers online.

Electronics legislation

Product stewardship and e-waste laws

Product stewardship laws set up mechanisms and requirements where manufacturers participate in the management (or at least the cost of the management) of the whole life cycle of a product. These laws are often also called Producer Responsibility laws. Currently 25 states in the U.S. have some kind of electronics product stewardship law.

Each state has tackled the problem slightly differently. The largest number of them (including Oregon) have introduced *consumer take back* programs where electronic product manufacturers finance and provide a statewide program to take back unwanted electronic equipment from consumers. There is no fee charged when the product is taken in for recycling; rather that fee is included in the price of the product or is charged when the product is purchased. These programs usually include the support of a collection system so that consumers throughout the state can identify nearby locations to safely discard their electronics.

As these types of laws increase, manufacturers will share the burdens associated with energy use, recycling and disposal of their products. This could encourage the companies to design products to last longer, use less energy and be easier to open and replace parts for repairs.

Some states (like Washington) have only passed producer responsibility laws. These laws make it easier for people to recycle because they remove the cost barrier. Some state electronics discards laws (like Oregon's) combine producer responsibility and regulation of discards along with a ban on electronics landfilling.

The Oregon E-cycles program collected 26,225,761 pounds of electronic devices in 2016. That's around 6.41 pounds per capita. When the law first went into effect in 2010 there was a flood of old electronics that people had stored in their basements waiting for a free and reliable way to recycle them. Oregon is probably approaching the peak in terms of pounds of electronics collected per year for two reasons:

1. Most of the old electronics people were storing have now been collected, and what's now being collected is primarily end-of-life material.
2. Electronics are changing to be much lighter but also harder to take apart.

Electronics and the right to repair

A second intriguing front of electronics legislation focuses on preserving consumers' rights to repair the electronic products they have purchased. Kyle Wiens, founder of iFixit.org and the author of the Repair Manifesto, feels that the individual's right to repair is under assault. He points out that manufacturers are shifting their practices in a way that takes repair out of the equation. They have increasingly stopped making replacement parts, they frequently design products that break if you try to open them, and they often make specialized parts that cannot be replaced with universal ones. Wiens also points out that manufacturers have begun to claim proprietary rights to manuals and electronic chips that make these products run. Wiens states in Wired Magazine:

"Over the last two decades, manufacturers have used the DMCA (Digital Millennium Copyright Act) to argue that consumers do not own the software underpinning the products they buy — things like smartphones, computers, coffeemakers, cars, and, yes, even tractors. So, Old MacDonald has a tractor, but he owns a massive barn ornament, because the manufacturer holds the rights to the programming that makes it run."

If companies are able to successfully make this claim, then customers would be left unable to repair and maintain their electronics. This will increase purchases of new electronics and increase the negative environmental impacts associated with electronics manufacture and use. Lack of access to product manuals and parts also makes it so that local repair service shops would not have the tools they need to do their work. Kyle Wiens argues that the gradual shift from a repair service model to a throw away and purchase new model is also a shift from local businesses to international businesses in which workers may be subject to slavery and dangerous conditions.

Consumers and local businesses are beginning to tackle this problem. For example, in 2012 88 percent of voters in Massachusetts overrode the car companies and passed the automobile owners' Right to Repair law which requires motor vehicle manufacturers to allow vehicle owners and independent repair facilities in Massachusetts to have access to the vehicle diagnostic and repair information.

In 2015, the Digital Right to Repair Coalition worked with allies on the ground to introduce pro-repair legislation at the state level in New York and Minnesota. *Fair Repair* would do just what the name implies: it would make repair fair again. Fair for owners of digital equipment. And fair for independent repair facilities. If made law, Fair Repair would require manufacturers to provide owners and independent repair businesses with fair access to service information, security updates, and replacement parts.



DEEP DIVE

Learn more in ***We Can't Let John Deere Destroy the Very Idea of Ownership*** published in **Wired Magazine** (available online).

RESOURCE

You can learn more about *Fair Repair and the Right to Repair* movement on *iFixit's* and *The Repair Association's* websites.



CONCLUSION

While electronics have transformed our everyday lives they are also substantially transforming our earth. From extraction to end of life, electronics have many negative environmental and public health impacts. The minerals and metals required for electronics manufacture are hazardous to extract from the earth. Moreover, the profits generated from these activities are sometimes used to fund wars or support dictatorial or corrupt governments. Once the manufacturing stage is complete, it takes a great deal of energy to power our proliferating electronic devices. These devices tend to have relatively short lifespans, in part because of rapid technical innovation, but also due to planned obsolescence. As devices are replaced, old devices containing toxic materials can end up in the landfill or be disassembled overseas where there are few measures to ensure worker safety and public health.

Despite this daunting array of problems, promising solutions and strategies are emerging. Certification and rating programs can now help consumers avoid conflict minerals and purchase electronics that are less environmentally impactful. Electronics recycling is more widespread and many states now require manufacturers to fund free electronics collection programs. Individuals are discovering ways to prolong the life of their electronic devices and vibrant open source communities are creating free software that can avoid situations in which a new version of commercial software will not function on older hardware.

While these developments are promising and encouraging, the U.S. still lacks cohesive federal policies and legislation regarding electronics manufacturing, engineering and disposal. Only half of the states have passed electronics product stewardship laws. The right to repair may also be under siege, as some companies are claiming that the underlying software that makes a device or appliance run is proprietary. If such claims stand up to legal challenges then consumers and repair shops would be left unable to fix or maintain electronic devices.

CHAPTER 16 SUSTAINABLE BUILDING

INTRODUCTION

Buildings are the settings for most of our lives. We live in houses and apartments. We work in offices, retail centers, hospitals, schools and factories. And we worship, play and work out in still other buildings. Because we spend so much time in buildings we often forget that they are actually made up of materials just like the packaging around the food we buy. Throughout their life cycle buildings require natural resources just like less durable goods such as electronics and clothing. In fact, the decisions we make about the buildings around us can have much greater impacts on the environment than the vast majority of the day-to-day decisions that we make about other products because buildings are so big and so long-lasting.

We tend to think that building decisions are solely made by architects, contractors and construction workers and Master Recyclers often wonder what impacts they could possibly have or why they should consider spending some of their volunteer hours talking to the public about it. Certainly it will be helpful for residents to understand better how to hire a contractor for building and remodeling so that our values are built into the places we live. But it is also important that we understand the policies that influence the make-up and design of our buildings. It is also crucial to maintain already existing buildings that have so many natural resources invested in them so as to maximize their lifespan and their efficiency.



Whether we own or we rent our homes, are decision-makers or observers in the design and maintenance of our public places, we can all play a part in influencing the policies, planning, building, purchasing, remodeling, redecorating, fixing and maintaining of our buildings.



WHAT IS SUSTAINABLE BUILDING?

Habitat for Humanity defines sustainable, *green*, building as designing and constructing houses that are efficient and durable, that use less resources, are healthy to live in, and are affordable. This definition can be expanded to include our schools, office buildings, apartments, recreational centers and factories.

Sustainable building can:

- Manage stormwater that runs off the building.
- Save energy.
- Utilize alternative energy.
- Include green space and food production.
- Be located near services such as retail shops, medical care, schools, jobs, and transit.
- Locate housing and service buildings away from buildings with high health impacts such as manufacturing facilities.
- Invite community gathering and expression.
- Use non-toxic materials.
- Provide safe places for children to play.



Experts in the area of sustainable building will specialize in many of the subjects above, but this chapter will focus on an area that gets less discussion. We will specifically explore the full life cycle of the materials in buildings and the environmental and social impacts of the decisions we make about those materials.

We will learn that the reduction of materials that make up our buildings can be one of the most important ways in which buildings can be sustainable. Energy efficiency decisions are currently the most important environmental decisions we can make about buildings when it comes to climate. DEQ reports that 86 percent of the total carbon emissions associated with homes are due to energy use (space and water heating, electricity consumption). However, materials production contributes the remaining 14 percent, which is still significant. As we begin to build more and more energy efficient buildings, the percentage of the energy used to make the building materials will become proportionally greater. So along with energy efficiency, the materials we choose will be important in meeting the aggressive carbon emissions reductions necessary to curb climate change.

EMBODIED ENERGY IN BUILDINGS

More natural resources are contained in our buildings than in the products that we use day-to-day. These natural resources include building materials themselves and the energy required to process and transport those materials. Building materials include wood, iron and steel, non-ferrous metals, chemicals, natural gas and petroleum products, minerals such as cement and lime, and glass. Processing these materials requires water, oil and coal. Minimizing the need to extract these natural resources is reason enough to rethink our standard approach to building.

We don't often think about the amount of energy that is embodied in the materials that make up our buildings and the impact that embodied energy has on our climate. **Embodied energy** is the energy consumed by all of the processes associated with the production of a building, from the mining and processing of natural resources to manufacturing, transport and product delivery. Embodied energy does not include the operation and disposal of the building material, which would be considered in a life cycle approach. Embodied energy is the upstream or front-end component of the life cycle impact of a building.

Embodied energy in buildings is important because natural gas, oil and coal are widely used for energy to manufacture building materials and these fossil fuels, when burned, create carbon dioxide (CO₂) emissions, a primary cause of climate change.



Coal factory

The amount of energy embodied in regular household materials is high. The amount of embodied energy contained in an average, 2,000-square-foot home, is 892 million BTUs, the equivalent of 7,826 gallons of gasoline, enough embodied energy to drive an SUV 5.5 times around the earth.

TERM

Embodied energy : *The energy consumed by all of the processes associated with the production of a product, from the mining and processing of natural resources to manufacturing, transport and product delivery.*

RESOURCE

You can find more information on home remodeling and green remodeling options at the website of the National Association of Remodelers (NARI).

LESS IS BEST

The material that doesn't have to be extracted and manufactured is always the least environmentally costly. Below is an exploration of creative ways to think differently about how we work and live so that we can lessen the environmental impact of our buildings. These changes are big, but an increasing number of people are ready to embrace such changes not only to safeguard our environment but also to improve their quality of life. Our local governments are also including zoning and incentives programs that help remove some of the barriers to making these lifestyle changes.

Shared space

Condominiums, town houses and apartments are all types of housing that minimize building materials by sharing common walls, courtyard space, and parking and laundry facilities. Depending on their design, multifamily homes are capable of providing a 10 to 15 percent reduction in carbon emission in comparison to equally sized single family homes. Commercial, non-profit, government and private space can also be combined to minimize materials. Getting a roommate or renting out that extra room are also effective ways to utilize existing space.

Freelancers are also embracing the shared space concept. While working from home can save money, for the sake of creativity, productivity, and sanity, many freelancers choose to rent a desk in an office or co-working space.



Space can also be shared by different types of users. Churches and restaurants will often loan or rent out their large kitchens part-time to food cart cooks. Swap n' plays where families can share toys, bring their children to play, and swap clothing can be housed in buildings with extra or seldom used space.

Such approaches can have the added benefits of creating community gathering spaces, minimizing the need for transportation, and providing easy access to services. While people generally like privacy, there is a growing sense that privacy may come at the expense of feeling more

isolated and having to spend more time earning money to pay for a private home. More and more communities are forming where people choose to live, work and play together intentionally because they see the value of protecting our planet and like the safety and satisfaction that comes from knowing the people that live around them.

Size matters

Along with sharing space, we can reduce materials by living in smaller spaces. DEQ estimates that downsizing from Oregon's average house of 2262 sq. ft. to a still reasonable 1149 sq. ft. could reduce the carbon footprint of that household by between 20 percent and 40 percent. They argue that even making a moderate change in the size of your home can be one of the most environmentally beneficial decisions that you can make.

Tiny houses are a popular new movement where people choose to live even smaller. Tiny houses are typically 100 to 400 sq. ft. While tiny houses may not be for everyone, there are lessons to be learned and applied to how we all use space. Rather than expecting their individual home to meet all of their needs, people who live in tiny houses look to shared spaces nearby for play, entertaining and gathering.

People who choose to live in smaller spaces enjoy the added benefit of freeing up their income for other priorities. As a general rule housing should not exceed 30 percent of your income. In the Portland metro area, however, in 2014 the median gross rent was 33 percent of the gross income of renters and the median for home owners was 30 percent. We are living beyond our financial means, just as we are also overdrawing natural resources from our planet. Neither of these is sustainable. People who choose to live in smaller spaces frequently mention that they enjoy the ability to meet other basic needs with the savings in rent or taxes. Some also report enjoying reducing the amount of hours they have to work to make these payments.



ACCESSORY DWELLING UNIT

2010



2020



2040



■ Live ■ Rent

Evolving housing over time.

Space that evolves with time

We often plan our personal and public buildings for the times when they will be used at their maximum capacity. Often these peak use times, however, are short and some space is then unused most of the time. We can think of our buildings as less fixed and use the space more creatively to maximize efficiency and flexibility. Accessory dwelling units and modular buildings are two examples of how we can make our buildings more flexible so that their use can evolve over time.

An accessory dwelling unit is a really simple and old idea: having a second small dwelling right on the same property or attached to your single-family house. Planners call them ADUs (Accessory Dwelling Units), but they're also known as granny flats, in-law units, laneway houses, secondary dwelling units, and many other names. Such units are making a comeback. ADUs can include:

- An apartment over the garage.
- A tiny house in the backyard.
- A basement apartment.

Flexibility in housing makes sense for environmental, lifestyle, and financial reasons. Many people buy houses to live in for decades. But they often purchase a house to fit their family at its largest. This can leave unused space as family size changes. It is still relatively unusual to consider how the use of space can change over time.

RESOURCE

To learn about incentives and regulations in your city, and how to get started on building an ADU you can visit the website for Accessory Dwelling, a nonprofit group based in Portland.

If you have a reasonably sized house, and an even more reasonably sized ADU, you've likely got a pretty green combination with flexibility as well. You could have your best friend, your mother, or your grown kid, live in the extra building. When you want to stop climbing stairs in a two-story house you can rent it out and live in your ADU. This kind of flexibility and informal support could really help as the nation's population ages. Most people want to stay in their homes as they age, but finances and design can be problematic. An ADU could help aging people meet their needs and enjoy the benefits of aging in a familiar home and community.

RESOURCE

*To learn more about commercial options for flexible buildings consult the Bureau of Planning and Sustainability's **Tenant Improvement Guide**.*

Commercial buildings can also be constructed in ways that allow for change of use over time by moving from standardized permanent internal structures to modular fixtures. Retail centers and office spaces can have separators, and electrical and furniture systems that easily come apart and can be moved around to adapt to rotating tenants. Even schools are beginning to utilize this building method. Modular schools can be created to allow for additional classrooms, a library, gymnasium, or additional stories and can be modified and expanded at later dates. When enrollments shift, so can the shape and function of the school's buildings.

REMODELING AND BUILDING CHOICES

Many green building strategies may be considered for remodeling or building a home, and many of these pertain to how materials are used. Making sustainable choices early in the process can reduce the use of resources, reduce waste generation during construction, and also eliminate future waste issues.

Recycled-content building products are made using materials recovered from the waste stream. The feedstock for recycled building materials can come from industrial castoffs, take-back programs, and curbside recyclables. Metro's recycled paint, UltraTouch™ insulation (made from waste denim cotton), and Shaw carpet that incorporates reclaimed plastic bottles are three examples of recycled-content building materials.

Using recycled-content materials closes the loop by turning waste into usable products, thus saving energy and natural resources, and often reducing pollution, including greenhouse gasses. However, these products are not without their challenges, such as their questionable future recyclability. For example, decking made from scrap wood and plastic waste will last longer than wood, but it's very difficult to recycle this composite material when the time comes to replace the deck. Often an even better choice is to use salvaged material. **Salvaged** material does not require the energy to process materials like recycling does and is often reuseable once again, unlike composite materials made from recycled resources.



Salvage Works lumberyard in Portland

TERM

Salvage: *The act of rescuing materials for reuse in the original form or the resulting material.*



Action Tips:

- When possible prioritize using salvaged materials.
- Select recycled content materials as a second best option.
- Choose durable, long-lasting products.
- Consider the future recyclability of recycled materials used.
- Ask about purchasing remnants of materials





Designing for disassembly facilitates the future reuse or recycling of select materials, even an entire building. For example, future harvesters will be better able to salvage lumber from today's dormer addition if headers and beams are fastened together with screws or nails, rather than the glue commonly used in modern construction.

Action Tips:

- Reduce the variety of materials.
- Prioritize materials for ceilings, walls, floors and cabinets that have smaller components that can easily be removed, repaired or swapped out.
- Use screws instead of adhesives.
- Select materials that are durable and long lasting. Some products may look new and slick, but are made cheaply with moving parts that break easily.
- Build so that common hand tools (hammer, crow bar, etc.) can be used in disassembly.
- Leave fasteners exposed.



Dematerialization simply means using fewer materials. This concept applies to all stages of production, including: resource extraction, design, manufacturing, and installation. Fewer materials use fewer natural resources, consume less energy, save money, and create less future waste.

Action Tips:

- Consider skipping the drywall for ceilings and walls that share other interior space and leave the main structure exposed.
- Use framing techniques that require fewer boards per wall.
- Limit the use of finishes.
- Landscape with native and hardy plants that require less maintenance, water and chemicals.
- Site, orient, and design buildings to use daylight as the primary lighting source.
- Do without ... a garage, a second bathroom, or an expanded kitchen.
- Think small; create multi-use spaces by adding creative storage and lounging options (e.g., Murphy beds, under-stair cabinets).
- Caution: Do not choose to use less material if the material can make the building more energy efficient. Insulation and finished walls are important ways to keep heated space warm.



In short, reduce, reuse, recycle is as vital a motto for building and remodeling as it is for everyday consumption.

TAKING CARE OF WHAT WE HAVE

Practicing a little maintenance and fixing problems before they get out of control can save a lot of time and money and maximize the embodied energy in building materials by ensuring that they last as long as possible. If you rent, you can still help conserve the materials in the buildings and keep your family healthy by doing a few small maintenance tasks yourself and by informing the property owner of bigger problems early. In Oregon, you can also arrange with the owner or property manager to fix essential items yourself and dock the costs off of your rent.

Got mold?

Moisture in or around the house can contribute to allergies or asthma and also cause structural damage in a home's walls, attic, foundation and exterior. In an average year, 22,000 gallons of rainfall will hit a 1,000 square foot roof in our region. With that amount of moisture, proper water management is essential to protect building materials. Here are a few easy ways to reduce moisture problems that everyone can do:

- **Foundations.** Ensure that landscaping drains water away from foundations. Regularly caulk areas where cement slabs sit next to the foundation. Clear debris from gutters and downspouts in the spring and fall, and replace parts that have rusted or fallen off. Make sure that downspouts drain water at least 6 feet away from a basement and 2 feet away from a slab or crawl space. Place a plastic vapor cover over dirt in a crawl space.
- **Moisture from interior sources.** Always use fans while taking a shower or in the kitchen while cooking. Ensure that the dryer vent sends moisture outside. Open windows and doors when the weather is warm and dry. Allow space between walls and furniture for ventilation. Have HVAC systems regularly serviced and repaired for proper air circulation.
- **Leaks.** Regularly check pipes to refrigerator, hot water heater, faucets and drains under sinks and laundry spigots. Look for leaks on roof, attic, behind gutters, and around windows and doors.
- **When mold appears.** Utilize fans or dehumidifiers and immediately remove carpets, drapes or furniture that has mold before the mold escalates. Professionals can also be called to clean mold.

Tool libraries and hardware tool rentals

You don't have to have a fully equipped toolshed to maintain your house or apartment. There are currently four Tool Libraries in Portland that loan a wide variety of tools to community members free of charge. Tool libraries benefit residents by reducing the costs of maintaining and improving the places in which we live, work, and play.

RESOURCE

For more on renters' rights visit Oregon's Community Alliance of Tenants (online).



The North Portland Tool Library, Southeast Portland Tool Library, Northeast Portland Tool Library, and Green Lents Community Library all have websites where you can find more information.

Many hardware stores also rent tools. From large companies such as Home Depot to smaller stores, it is worth contacting your local stores and seeing what tools they rent.

CONSTRUCTION AND DEMOLITION

TERM

Deconstruction: *the systematic disassembly of a structure in the opposite order it was constructed to maximize salvage of material for reuse.*

Buildings in the Portland metro area traditionally get built, demolished, disposed of, and built again with little consideration of waste reduction. Waste sort studies at local construction sites reveal that, while about 90 percent of the materials used in buildings are recoverable, only 50 percent are recovered. Construction generates the third largest waste stream in Oregon.

Construction and demolition waste in the metro region

The sources of construction and demolition (C&D) generated waste vary greatly in the Metro region. And the proportion of waste from residential, commercial, mixed use and industrial construction activity varies between rural and urban areas. However, several clear themes emerge from studies of building permit data:

- The majority of money in the region is spent on new commercial construction and commercial remodeling.
- Residential remodeling in the region is underreported due to unpermitted, bootleg activity, which is probably several times more prevalent than permitted projects.
- Little solid waste is created in civic projects like bridges and roads.

Deconstruction

Deconstruction is the systematic disassembly of a structure in the opposite order it was constructed to maximize salvage of material for reuse. Deconstruction is most often done by hand with machinery only being used to lower walls or load materials. The method of mechanically demolishing buildings, and then attempting to pull out materials for recycling, often results in damaged and mixed up materials, to the point where materials must be used for very low environmental benefits like burning for fuel. Deconstruction, on the other hand, results in whole pieces of building materials that are predominantly intact and can be reused in other sites.



Credit: Lovett Deconstruction

There are many benefits to deconstruction:

- The deconstruction of a 2,000 sq. ft. home can yield 6,000 board feet of lumber, enough for the construction of 660 sq. ft. of affordable housing. This amount of salvaged lumber is equivalent to 33 mature trees, or the yearly output of 10 acres (that's 7 football fields) of planted pine.
- Deconstruction supports six to eight jobs for every one job associated with traditional mechanized demolition.
- Salvaging reusable material supports the local economy, creates viable local enterprises, and offers an affordable option for residents and businesses to acquire quality used building materials such as old-growth lumber.
- Deconstruction offers greater carbon benefits by preserving the embodied energy of existing building materials and avoiding the creation of greenhouse gases associated with landfilling waste.
- When salvaged building materials are donated to a non-profit such as the Rebuilding Center, there is a tax deduction for the materials if they are donated.
- Deconstruction companies and non-profits often have competitive bids against companies that use conventional demolition methods because they pay less landfilling fees and receive money from the sale of salvaged materials.

First deconstruction law in the country

Antique glass doorknobs, wood framing from long-gone old growth forests, basket weave bathroom tiles, and inlaid hardwood floors are all beloved touches in old homes. Instead of stripping our forests and land for natural resources to decorate and build our new homes, we can harvest materials at local reuse centers like the ReReBuilding Center and Habitat for Humanity ReStore.

Recognizing the value and benefits of salvaging building materials for reuse, Portland City Council approved in July 2016 the first ordinance of its kind in the country that required development to fully deconstruct homes built in or before 1916 instead of demolishing them. In 2020, the ordinance was expanded to 1940 or earlier, resulting in approximately over 100 deconstructions or about two-thirds of house demolition permits. These houses are taken apart by hand, allowing materials to be separated for reuse and recycling while creating pathways to deconstruction careers. The Bureau of Planning and Sustainability also created incentives to use deconstruction and developed training for workers and contractors who want to learn this trade.



Credit: Lovett Deconstruction



“Our goal is to preserve neighborhood character and affordability by discouraging demolitions, but when buildings do come down, that work should still serve the public good. Taking apart buildings in a way that allows for salvaging valuable materials for reuse benefits our community, economy, and environment.”

— Charlie Hales, Mayor
City of Portland, 2013-16

RESOURCE

To find contractors, learn about trainings, and find incentives you can visit the City of Portland, Bureau of Planning and Sustainability’s webpages, **Explore Deconstruction.**

Present C&D waste practices

Successful waste reduction planning for construction and demolition requires a good understanding of present practices. This section looks at what kinds of C&D activity takes place in the metro region, what materials are generated, and how the materials are usually disposed of.

Building materials in the waste stream

Over 250,000 tons of C&D materials are generated each year in the region. These are primarily wood, metal, corrugated cardboard, concrete, drywall and roofing. Some new materials and composites are difficult to recycle, but they're a small part of the dry waste stream. Pure loads of concrete, asphalt, and dirt are not counted as part of the solid waste system tonnage, as they would eclipse the quantity of solid waste in the system many times over.

Typically, the generation of individual materials follows a predictable schedule (for example, all drywall scrap is generated in the two days after the drywall is installed).

The quantities of the six C&D material types are also very consistent and predictable. Such predictability in types, timing, and amounts of materials could facilitate source separation for recycling.

The demolition phase of any construction project is usually where more than 60 percent of C&D debris is generated. This makes demolition activity a huge opportunity for recycling and reuse. Renovation and remodeling comprise the next largest debris-generating activity, making this yet another area with great potential for waste prevention and reduction.

Hauling

The building industry presently relies on three primary methods for hauling C&D debris: drop boxes, self-haul, and a cleanup contractor. Many builders use a combination of these options, depending on the materials being used and the phase of the project.

To encourage C&D waste reduction, a successful education program must include source separation strategies for use with all three hauling methods. Contractors' hauling choices will determine whether separating recyclables on site is possible, or whether separation will have to happen at a Materials Recovery Facility that serves C&D customers.

- **Drop box.** About half of the region's C&D tonnage is hauled in drop boxes, which are hard to move, bulky, and incur daily rental fees. Drop box hauling tends to be used during the demolition phase, which produces the bulk of material and can be done fairly quickly. Contractors usually mix all debris in one drop box.

One way to source separate with this hauling method is to use a box for each material. However, there are many challenges that make this

option unfavorable to contractors. Larger projects may still have limited space for multiple boxes. Small projects often only generate enough debris to fill one box. Multiple containers for source separating in these conditions usually cost more than one large container where debris is mixed.

- **Self haul.** The second most utilized method is self hauling. Contractors use everything from a pickup or trailer load to a 20-yard dump truck. Source separation is usually much easier with this hauling technique as materials can each be hauled directly to the proper recycler.
- **Clean-up contractor.** This specialized service provider comes to the job site several times over the life of the project to collect, sort and haul off debris. Contractors usually pay more for this service, but it takes waste management off of their list of things to do and makes a sub-contractor responsible for the entire task. Clean-up contractors work best on new single-family residential developments of five houses or more.



Disposal

Mixed dry waste (also known as limited-use) facilities accept loads of mixed paper, wood, metal, and glass for processing. They do not accept food or other organic waste. Some accept both source-separated recyclables and mixed dry waste. Mixed C&D trash is sorted for recycling by these facilities. On average, 25 to 30 percent of mixed dry waste loads are recovered for recycling at dry waste facilities.

In the metro region, the Enhanced Dry Waste Recovery Program (EDWRP) requires that all mixed dry waste be delivered to a Metro-authorized dirty MRF that will separate the waste into marketable components and that dirty MRFs must ensure that their processing residual contains no more than 15 percent of wood, metal and cardboard. Portland has additional requirements. For all building projects within the city where the total job cost (including both demolition and construction phases) exceeds \$50,000, the general contractor shall ensure that 75 percent of the construction waste produced on the job site is recycled.



Metro placed a suspension on the EDWRP requirements for wood recycling because of the closure of the WestRock paper mill in Newberg that used to burn 85% of the region's urban wood as boiler fuel. WestRock's closure means that painted and treated wood generated in the Metro region is now being disposed of. Two other, smaller paper mills in Washington continue to accept clean and unpainted/untreated wood from the Metro region as boiler fuel to produce steam and electricity.

As part of an effort to move wood waste up the waste hierarchy, Metro began a multi-phase project in 2014 to identify and develop Metro area alternative end-markets for wood waste. Likely first steps will include an increased focus on recovery of reusable wood pieces at Metro Transfer Stations.

To ensure the safety of customers and the public, Metro requires paperwork for all loads of construction, remodeling or demolition waste for materials that may contain asbestos. Loads of construction, remodeling and demolition debris brought to Metro transfer stations is thoroughly screened for materials that may contain asbestos. Find information about how to identify asbestos and protect yourself, your family and neighbors from it on the Department of Environmental Quality's website.

Construction projects will find that most facilities that traditionally take wood waste or construction and demolition materials will either refuse the material or require proof that it does not contain asbestos. Visit Metro's Find a Recycler (online) to get the latest information about what is accepted in your area.



Metro's programs, tools, and resources for the construction and demolition (C&D) sector build on 30 years of research, demonstration projects, infrastructure grants, education programs, and partnership work with the building industry and workforce development organizations. Current programs include:

Metro Construction Industry Partnership Project

Metro partners with the region's construction industry associations and green building associations to encourage source separated recycling and building material salvage practices. This ongoing outreach effort has media, retail, and public project components all designed to support C&D waste reduction. (Surveys have shown that builders now look to Metro as a trusted source of information about recycling and that they are consistently using Metro's Toolkit and other resources to make decisions about waste and recycling.)

Metro Find a Recycler

The on line Metro Find a Recycler includes providers of reused building materials, deconstruction services and construction debris recycling options. This resource is updated daily and lists over 100 recycling and reuse facilities that accept C&D materials.



CONCLUSION

Most Master Recyclers will be talking to residents who are not contractors or architects, but who may be considering a remodel or other house project. You can still help get the word out about these important ways to minimize the need for new resource intensive materials, to maximize the use of salvaged materials, and to implement other sustainable building practices.

Here's a quick list of questions you can encourage people to ask their contractor or consider if they are doing the job themselves:

- Can you salvage any materials on this job to reuse or donate/sell?
- Are you separating or mixing recyclables?
- Where are you taking materials for recycling/reuse?
- What can you do to reduce waste?
- Question whether replacement/upgrades are the best options.

If you are interested in more formalized opportunities for outreach and education there are certainly many possibilities. Information about remodeling or construction is generally most welcome and effective when people are actively considering a remodel or buying a home. The Rebuilding Center regularly requests help from Master Recyclers to staff information booths at home and garden and remodel shows because people are actively seeking ideas at

these events. Look in the Master Recycler newsletter for the next opportunity. Home buying fairs are other community events where people are just learning to take care of the biggest purchase of their lives. Consider looking up these events and contacting the organization to see if they would let you set up a booth. You can check out the Remodel-it Green kit to act as your display.

Master Recyclers have also worked on personal projects focusing on green buildings. Two of the tool lending libraries had Master Recyclers in their founding teams. One Master Recycler was the administrative assistant at REACH. She worked with the Green Building team there and the City of Portland Sustainability at Work program to develop and pass a Green Building Policy so that all future affordable housing will use green building practices. A team of Master Recyclers in Hillsboro worked together to make changes to their old church and followed steps to get their building certified as a Green Sanctuary through the Unitarian Universalist Association.

Master Recyclers have and will continue to play important roles in our collective transformation to more sustainable building (and dwelling) practices. Given the sheer volume of natural resources, pollution and energy required to make these structures and their importance in our daily lives, these it will be volunteer hours well spent.