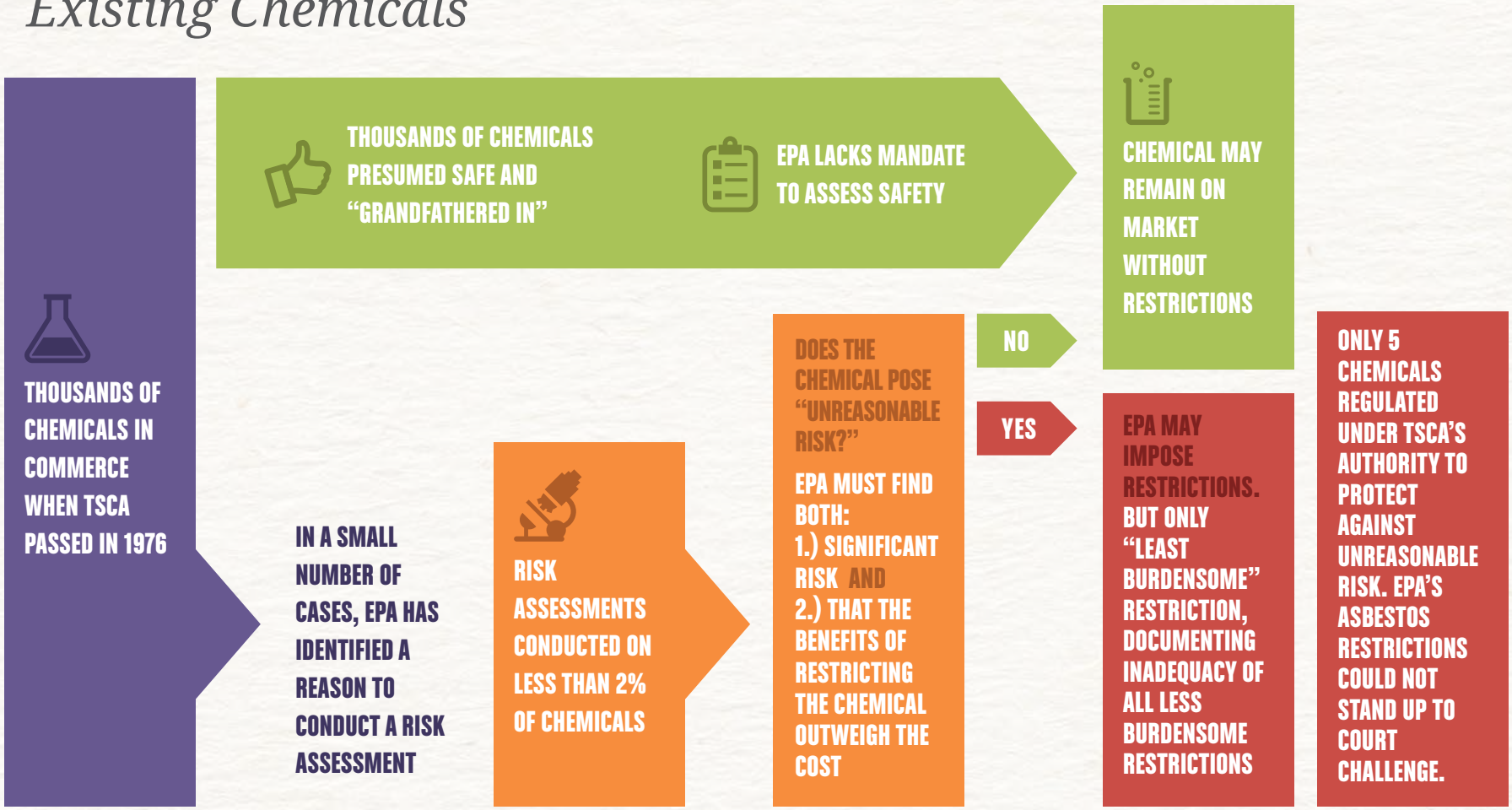
2.

MATERIAL HEALTH CHEMISTRY

These diagrams, tables, and charts illustrate the challenges in evaluating the unregulated chemicals that are present in household, personal, and building products. These references can be used to set a chemical priority strategy while offering a framework for Green Chemistry.

How the Toxic Substances Control Act Evaluates Chemicals

Existing Chemicals



Environmental Working Group, Accessed 2017

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LAW*	SUMMARY
Environmental protection	
Clean Air Act	Requires EPA to set and enforce air quality regulations, including ambient standards, emission permits, and industry-specific contaminant emission standards
Clean Water Act	Requires EPA to set and enforce water quality regulations, including guidelines for water quality, discharge permits, and national industry-specific wastewater discharge standards
Resource Conservation and Recovery Act	Authorizes EPA to regulate generation, transportation, treatment, storage, and disposal of hazardous waste, and to set provisions for solid waste management, including materials recycling
Lacey Act	Prohibits importation of illegally harvested wood
Chemicals production and use	
Toxic Substances Control Act	Establishes conditional authorities for testing, reporting, regulating, or restricting certain chemicals
Federal Insecticide, Fungicide, and Rodenticide Act	Establishes system for registration and review of pesticides, including antimicrobials
Federal Hazardous Substances Act	Authorizes regulations and restrictions of certain household hazardous substances meeting criteria
Formaldehyde Standards for Composite Wood Act	Requires EPA to set standards for formaldehyde emissions from composite wood products
Emergency Planning and Community Right-to-Know Act	Requires covered companies to report certain information on hazardous and toxic chemicals at facility level, including releases to environment above thresholds; resulted in Toxics Release Inventory
Worker protection	
Occupational Safety and Health Act	Authorizes standards for workplace health and safety, including chemical exposure
Consumer products safety	
Consumer Product Safety Act	Authorizes safety standards for certain consumer products on commercial market
Flammable Fabrics Act	Restricts sale of highly flammable fabrics in furnishings, among other things

Table 1: Criteria for prioritizing chemicals based on persistence, bioaccumulation, health endpoints and confidence in the science

	Very High Concern	**Persistent Organic Pollutants** (POPs) targeted in the Stockholm POPs treaty and other **Persistent Bioaccumulative Toxicants (PBTs)***	Highest priority to eliminate
	High Concern	Known or likely **carcinogens, mutagens, reproductive** toxicants, **developmental** toxicants or **endocrine** disruptors.	
	Moderate Concern	Significant possibility of above hazards but lower confidence *or* known or likely **neurotoxicants, respiratory** sensitizers or leading to **other chronic human or ecotoxicity** endpoints.	
	Caution	Moderate concern for any of the above health endpoints *or* preliminary indications of higher concern but with inadequate test data or acute human health concern	Use with caution. Avoid where possible
	Low Concern	Tested with low concern for any of the above endpoints**	Prefer

See Appendix B for explanation of criteria and how various chemical lists are ranked by these criteria.
* includes chemicals which are very persistent and bioaccumulative but toxicity is unknown.
** This paper reports on the chemicals that fall in the Moderate to Very High categories, not Caution or Low. Few authoritative lists yet identify chemicals for "Low" categorization.

The 12 Principles of GREEN CHEMISTRY

Green chemistry is an approach to chemistry that aims to maximize efficiency and minimize hazardous effects on human health and the environment. While no reaction can be perfectly 'green', the overall negative impact of chemistry research and the chemical industry can be reduced by implementing the 12 Principles of Green Chemistry wherever possible.

1. WASTE PREVENTION

Prioritize the prevention of waste, rather than cleaning up and treating waste after it has been created. Plan ahead to minimize waste at every step.

2. ATOM ECONOMY

Reduce waste at the molecular level by maximizing the number of atoms from all reagents that are incorporated into the final product. Use atom economy to evaluate reaction efficiency.

3. LESS HAZARDOUS CHEMICAL SYNTHESIS

Design chemical reactions and synthetic routes to be as safe as possible. Consider the hazards of all substances handled during the reaction, including waste.

4. DESIGNING SAFER CHEMICALS

Minimize toxicity directly by molecular design. Predict and evaluate aspects such as physical properties, toxicity, and environmental fate throughout the design process.

5. SAFER SOLVENTS & AUXILIARIES

Choose the safest solvent available for any given step. Minimize the total amount of solvents and auxiliary substances used, as these make up a large percentage of the total waste created.

6. DESIGN FOR ENERGY EFFICIENCY

Choose the least energy-intensive chemical route. Avoid heating and cooling, as well as pressurized and vacuum conditions (i.e. ambient temperature & pressure are optimal).

7. USE OF RENEWABLE FEEDSTOCKS

Use chemicals which are made from renewable (i.e. plant-based) sources, rather than other, equivalent chemicals originating from petrochemical sources.

8. REDUCE DERIVATIVES

Minimize the use of temporary derivatives such as protecting groups. Avoid derivatives to reduce reaction steps, resources required, and waste created.

9. CATALYSIS

Use catalytic instead of stoichiometric reagents in reactions. Choose catalysts to help increase selectivity, minimize waste, and reduce reaction times and energy demands.

10. DESIGN FOR DEGRADATION

Design chemicals that degrade and can be discarded easily. Ensure that both chemicals and their degradation products are not toxic, bioaccumulative, or environmentally persistent.

11. REAL-TIME POLLUTION PREVENTION

Monitor chemical reactions in real-time as they occur to prevent the formation and release of any potentially hazardous and polluting substances.

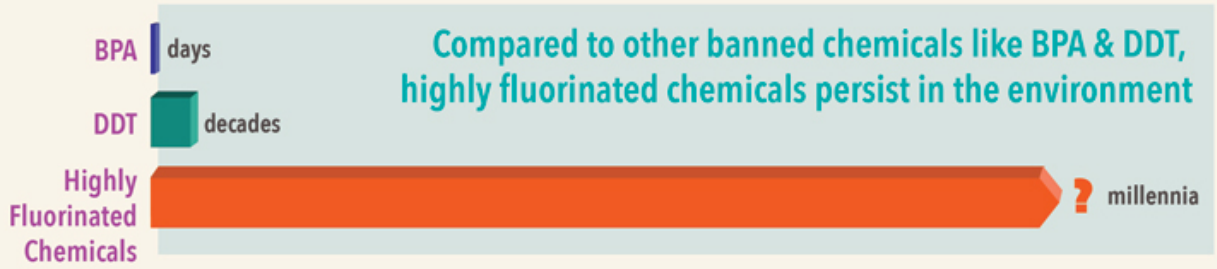
12. SAFER CHEMISTRY FOR ACCIDENT PREVENTION

Choose and develop chemical procedures that are safer and inherently minimize the risk of accidents. Know the possible risks and assess them beforehand.

Compound Interest, 2015

Many non-stick, waterproof, and stain-resistant products contain ***highly fluorinated chemicals***. Though these products are convenient, they can harm our health and our environment.

HOW LONG DOES NON-STICK STICK AROUND?



Why is that a problem?

The few highly fluorinated chemicals that have been studied are linked with:

- cancer
- obesity
- liver malfunction
- thyroid disruption
- high cholesterol
- hormonal changes
- low birth weight & size
- ulcerative colitis

What are they in?

Highly fluorinated chemicals can be found in:

clothing & outdoor gear | carpets, furniture & housewares | cookware | paper food packaging | cosmetics

How can I avoid them?

- **AVOID** "perfluor-" "polyfluor-" "PTFE" in ingredient lists
- **CONSIDER** the harm before buying products with these chemicals
- **ASK** manufacturers for products without fluorinated chemicals
- **MORE TIPS** at GreenSciencePolicy.org/highly-fluorinated-chemicals

Green Science Policy Institute, Accessed 2017

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Nanosafety:
the big picture
CSIRO
WHAT ARE NANOPARTICLES?
Chemicals or objects that are 1-100 nanometers
That's about an 8,000th of a human hair in width
They have unique characteristics
NANOPARTICLES OCCUR NATURALLY IN OUR ENVIRONMENT
Clay
Volcanic ash
Milk
Ocean spray
THEY ARE ALSO MANUFACTURED FOR USE IN EVERYDAY PRODUCTS
Next-gen computer chips
Medical implants
Sunscreens & cosmetics
Sporting equipment
WHY DO WE NEED TO RESEARCH NANOSAFETY?
Nanoparticles can be more conductive, stronger or chemically reactive than larger particles of the same substance.
The properties that make nanomaterials promising for manufacturing, could also present new unknown risks.
Our research seeks to find out what potential effects nanoparticles have in the workplace, on human health and on the world.
This research helps to inform Australian Government policy and regulators.
OUR GOAL:
TO DEVELOP NOVEL NANOMATERIALS WITH SAFETY IN MIND
WWW.CSIRO.AU/NANOSAFETYTHEBIGPICTURE

CSIRO, 2014

SETTING PRIORITIES

ELIMINATING *NON-FUNCTIONAL* CHEMICALS

Non-functional chemicals are those that are non-essential to a product's function, and can typically be removed immediately. You can begin incremental change by eliminating these *non-functional* chemicals, such as antimicrobials, fluorinated chemicals, and flame retardants. Because of the cost of these chemicals, manufacturers can save money by not including them.

ANTIMICROBIALS

examples: triclosan, triclocarban, quaternary ammonium compounds (quats), nanosilver

COMMONLY FOUND IN:

- Paints
- Touchable surfaces such as countertops
- Carpets
- Upholstery fabrics

Antimicrobials (sometimes referred to as biocides, pesticides, anti-fungals, anti-bacterials, or anti-virals) are added to products in order to kill and inhibit the growth of microorganisms. However, there is no evidence to show that interior products with added antimicrobials result in healthier occupants. Instead, antimicrobials have been shown to accumulate in food, water, and bodies, and can cause hormonal disruption and antibiotic resistance.

FLUORINATED CHEMICALS

examples: PFOA, PFOS

COMMONLY FOUND IN:

- Carpets and rugs
- Upholstered furniture
- Non-stick cookware

Fluorinated chemicals, or PFAS (perfluoroalkyl and polyfluoroalkyl substances), are often added to products and furniture as a stain-resistant coating. PFAS are highly persistent in the environment and bioaccumulate in the environment, wildlife, and humans. They have been linked to kidney and testicular cancer, thyroid disease, and hormonal disruption.

FLAME RETARDANTS

examples: chlorinated tris (TDCPP), PBDE

COMMONLY FOUND IN:

- Upholstered Furniture
- Building insulation

Flame retardant chemicals are often added to products in order to meet certain flammability standards. However, they only cause a small delay in fires, and make fires more dangerous by causing more smoke and more toxic emissions. Additionally, many flame retardant chemicals offgas and break down, ending up in air, dust, and water, and eventually in human bodies. Different flame retardants have been linked to cancers, neurological effects, and hormonal disruption.

Citations

Coffin, Melissa, Tom Lent, Susan Sabella, Jim Vallette, Bill Walsh, Mary Dickinson, Suzanne Drake, Robin Guenther, Max Richter, and Brodie Stephens. "Healthy Environments: Understanding Antimicrobial Ingredients in Building Materials." Perkins + Will and Healthy Building Network. 2017.
Green Science Policy Institute, Antimicrobials | Six Classes 2017. Video.
Green Science Policy Institute, Flame Retardants | Six Classes 2017. Video.
Green Science Policy Institute, Highly Fluorinated Chemicals | Six Classes 2017. Video.

Healthier Hospitals

A PRACTICE GREENHEALTH PROGRAM

Safer Chemicals: An Overview

The HH Safer Chemicals challenge provides hospitals with the tools and resources to choose health care products that are free from harmful chemicals.

www.healthierhospitals.org

Why Is The Safer Chemicals Challenge Important For Hospitals?

MORE CHEMICALS are used in health care than in any other sector. Many of these chemicals are harmful to individual health, public health & the environment.

Committing To Safer Chemicals With Healthier Hospitals

Level 1	Commit to one of the following: Green cleaning, PVC and DEHP elimination, healthy interiors, mercury elimination.
Level 2	Commit to two of the following: Green cleaning, PVC and DEHP elimination, healthy interiors, mercury elimination.
Level 3	Commit to three of the following: Green cleaning, PVC and DEHP elimination, healthy interiors, mercury elimination.
Level 4	Commit to four of the following: Green cleaning, PVC and DEHP elimination, healthy interiors, mercury elimination.

Metrics For Success: Safer Chemicals Measure Details

Green Cleaning

Inventory cleaning products & purchase 90% Green Seal or UL ECOLOGO certified cleaning products in the following categories: carpet, window, all purpose, bathroom, & general floor care.

PVC & DEHP Elimination

Eliminate PVC and DEHP from at least two product categories.

Healthy Interiors

Ensure that 30 percent of the annual volume of furnishings and furniture purchases (based on cost) eliminate the use of formaldehyde, perfluorinated compounds, (PVC), antimicrobials, and all flame retardants.

Mercury Elimination

Achieve mercury-free status or develop and implement mercury elimination plan.