

*Features – Changing Policy*

**PRECAUTIONARY POLICIES IN LOCAL  
GOVERNMENT: GREEN CHEMISTRY AND  
SAFER ALTERNATIVES**

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**ABSTRACT**

Local governments like the City and County of San Francisco have shouldered the burden of toxic chemicals released into the environment through the substantial costs of health care, environmental cleanup, and infrastructure to purify drinking water, manage wastewater, and manage solid waste. Cities can no longer afford to wait for federal regulation to prevent toxic chemicals from appearing in products used locally. San Francisco's Precautionary Principle Policy calls on the City to act on early warning signs of harm and to use the best available science to identify safer alternatives. Under its umbrella, a wide array of policy tools have been utilized including financial incentives through procurement contracts, certification and promotion of safer business practices, requirements for information disclosure, and bans and restrictions on the sale of products when safer alternatives are readily available. These policies can often become the models for regional, state, and national change.

**Keywords:** alternatives assessment, precaution, government

While San Francisco is unique in many ways, including its political status as both a city and a county, the environmental and public health challenges faced by this local government are commonplace. It is not news that toxic chemicals commonly found in consumer products and used by local businesses are contaminating our air, water, and land. Evidence is mounting that these chemicals have made their way into our bodies and are potentially causing irreversible harm in the form of developmental diseases and cancer [1].

Furthermore, our federal system for regulating chemicals in commerce (the Toxic Substances Control Act) does not require full assessment of the hazards of chemicals before they are allowed in the products found in homes and businesses—and about 1,000 new chemicals are added annually to the already-long list of approximately 80,000 chemicals in commerce [1]. Thus the current regulatory structure controlling the chemical makeup of products in commerce leaves cities across the United States vulnerable to ongoing exposure to chemicals whose full long-term impacts are not understood.

### END-OF-PIPE SOLUTIONS

Cities and counties represent the final resting place for products as they go from being considered useful and usable items into waste. Whether the disposal of unwanted products and materials is on land or in water, it is ultimately the responsibility of local jurisdictions to create and manage the infrastructure that prevents harmful chemicals from polluting our natural resources and protects the health of residents and the environment. The end-of-pipe systems developed to treat wastewater and solid waste cost city governments collectively billions of dollars every year. Despite this substantial investment, municipal waste management systems are unable to prevent the release of a wide array of potentially harmful chemicals into the environment. And whether the ultimate exposure to toxic chemicals found in products occurs in production, use, or disposal, local health systems funded by cities and counties are increasingly faced with the financial burden to deal with any resulting acute and chronic illness [2]. In the absence of an adequate federal system to safeguard public health and the environment from toxic chemicals in products, as well as an inadequate and costly reliance on end-of-pipe chemicals management strategies, cities like San Francisco are looking for policies and programs that will promote the use of safer alternatives and influence the way products are designed and delivered.

#### Wastewater Infrastructure

The federal government sets strict standards for the quality of the water that is discharged from wastewater treatment plants in order to prevent chemicals identified as *priority pollutants* from being released into surface waters [3, 4]. San Francisco, like all other municipalities, spends hundreds of millions of

dollars each year operating treatment plants for its sewer and stormwater system in order to maintain compliance with these standards.

However, wastewater treatment is an imperfect solution to toxic contamination. Most plants were built in the 1970s and 1980s, and therefore do not include processes required to remove more recent chemicals of concern, such as polybrominated diphenyl ether flame retardants (PBDEs), the antimicrobial triclosan, or the myriad pharmaceuticals that enter the waste stream. Although new monitoring studies reveal an ever-growing list of potentially harmful chemicals in the environment, we are limited in our ability to retrofit typical wastewater systems to capture them. It is estimated that, for Orange County in Southern California (with a somewhat smaller sewage treatment capacity than San Francisco), upwards of \$485,000,000 would be required to construct a sewage treatment plant with the reverse osmosis and other technologies that would enable the capture of chemicals like PBDEs, triclosan, and other emerging pollutants [5].

In addition to the cost of cleaning up the liquid effluent, sewage treatment facilities must manage the solid fraction of the sewage, known as biosolids or sludge, which may contain the chemicals that are removed from the wastewater. San Francisco produces about 82,000 tons of biosolids each year [6]. Almost half of that material is shipped to agricultural land for use as fertilizer [7]. Increasingly, the potential for chemicals to migrate out of the sludge into the land where it is applied will present a challenge for cities in the coming years [8].

### **Solid Waste Infrastructure**

Even with San Francisco's noteworthy recycling rate of 77 percent in 2009 [9], the City still deposits approximately 560 tons of waste into the local landfill each year. The State of California requires landfills constructed after 1988 to have special liners to prevent leakage. However, in the normal course of landfill operation, liquid leachate must still be collected and processed so as to prevent contamination of groundwater and surface waters. This leachate contains a wide array of chemicals originally found in the disposed products. For example, a recent study of the leachate coming out of three landfills in Maine showed the presence of 47 different pharmaceuticals [10]. Landfills across California that were constructed before the state's rigorous regulatory requirements took effect have been shown to contaminate adjacent aquifers and properties [11].

Even if a landfill is not within the borders of a particular city or county, local governments have faced liability under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) when landfills to which they had contributed became Superfund sites; in these cases, the local governments may be among the responsible parties identified to help cover costs for cleanup [12]. In addition, because of concerns over contamination from landfill leachate, the State of California has banned some classes of consumer products

containing heavy metals or other toxic constituents from disposal in municipal landfills. Examples of product categories currently banned from municipal landfills in California are fluorescent lights, paint, electronics, and household batteries. The financial burden to find alternate disposal paths for those products again falls on the shoulders of local governments. As knowledge of the toxicity of chemicals found in consumer products grows, the list of banned products and burden on local budgets to manage them safely is sure to grow as well.

Thus, federal and state regulations set the standards for the performance of waste management technologies, while local governments must raise the public funds to build and maintain them. Because end-of-pipe solutions such as wastewater treatment plants and landfills are expensive and cannot keep up with the ever-growing array of chemical constituents in the product waste stream, local governments have a significant interest in changing the paradigm for product manufacture by adopting the precautionary principle and increasing the availability and use of safer alternatives.

### **GREEN CHEMISTRY, THE PRECAUTIONARY PRINCIPLE, AND ALTERNATIVES ASSESSMENT**

Influencing the paradigm for product manufacture can take many forms, including the promotion of extended producer responsibility or lobbying for broad, federal- or state-level chemicals policy reform. San Francisco enacted policies that look upstream in the chain of commerce to influence the design of products entering across its borders and promote the use of safer chemicals. Many of these policies fall under the umbrella of the Precautionary Principle, and also connect strongly to the themes of Green Chemistry.

While the clear set of Green Chemistry principles widely cited from the book by Paul Anastas and John Warner [13] offers an important roadmap for lab chemists and product designers, it does not serve as a useful policy tool for local elected officials seeking to protect public health through local initiatives. Yet the underlying themes within the Green Chemistry principles of reducing waste, eliminating toxic by-products, and maximizing efficiency are clearly shared by San Francisco policymakers and city staff alike. In addition, the imperative to proactively design chemical hazards out of new products has won support at the state level in California, through the Green Chemistry Initiative and the passage of AB 1879 and SB 509 [14].

San Francisco's formal policy commitment to the Precautionary Principle (and, by extension, to Green Chemistry) began in 2001. The City's elected officials are well aware of scientific studies that reveal the significant impact of chemicals on ecosystems and on human health, and support the concepts embraced by Green Chemistry as they relate to product redesign [15]. However, they lacked the scientific training to interpret scientific reports on toxic hazards, or to resolve conflicting research findings. The slow pace of the scientific process

presented additional challenges to policymakers, since data that unequivocally prove cause and effect can lag far behind earlier evidence of environmental degradation and public health impacts. Aware of these limitations—and faced with increasing pressure from community-based organizations to take action to prevent harm from toxic chemicals in the environment—San Francisco leaders directed the Department of the Environment to explore policy frameworks that would enable robust and defensible decision-making to protect public health in the face of such scientific uncertainty [16].

In early 2002, a group of local environmental organizations joined with San Francisco city staff and the San Francisco Commission on the Environment to craft the policy framework that would become the nation's first Precautionary Principle Ordinance [17]. The policy document was inspired by the frequent references to the Precautionary Principle found within European policy [18], the 1992 Rio Earth Summit Declaration [19], and the findings of the Wingspread Conference in 1998 [20]. In 2003 the Precautionary Principle Ordinance became the umbrella decision-making framework (Chapter 1) for a set of environmental laws known as the San Francisco Environment Code [21]. As stated in the Ordinance, the five key elements required for precautionary decision-making are:

1. *Anticipatory Action:* There is a duty to take anticipatory action to prevent harm. Government, business, and community groups, as well as the general public, share this responsibility.
2. *Right to Know:* The community has a right to know complete and accurate information on potential human health and environmental impacts associated with the selection of products, services, operations or plans. The burden to supply this information lies with the proponent, not with the general public.
3. *Alternatives Assessment:* An obligation exists to examine a full range of alternatives and select the alternative with the least potential impact on human health and the environment including the alternative of doing nothing.
4. *Full Cost Accounting:* When evaluating potential alternatives, there is a duty to consider all the reasonably foreseeable costs, including raw materials, manufacturing, transportation, use, cleanup, eventual disposal, and health costs even if such costs are not reflected in the initial price. Short- and long-term benefits and time thresholds should be considered when making decisions.
5. *Participatory Decision Process:* Decisions applying the Precautionary Principle must be transparent, participatory, and informed by the best available science and other relevant information.

An important emphasis of the final policy language was an affirmation of the shared responsibility of citizens, business groups, and local governments to make decisions that prevent harm before potentially irreversible damage is

done. What was needed was an implementation strategy. Without direct knowledge of the work of Warner and Anastas to develop a framework for “Green Chemistry,” San Francisco created a policy in line with those principles that sought to drive the marketplace towards the development of safer, less toxic products and services. The mechanism selected to achieve this outcome was that of alternatives assessment.

While government decisions regarding the acceptability of products and services are traditionally based on a risk assessment/management approach, San Francisco selected alternatives assessment as a key tool for implementing the Precautionary Principle, based on the work of Dr. Mary O’Brien [22]. Alternatives assessments enable the comparison of negative impacts, benefits, efficacy, and costs of an array of potential product or service options. The available science for each alternative is considered, allowing decision-makers to select the alternative causing the least harm. O’Brien contrasts a traditional risk assessment, which evaluates a single chemical or process in isolation, to an alternatives assessment, where a wider net is cast for alternatives and, in her words, “instead of asking how much harm is allowable, we ask how little harm is possible” [22].

The San Francisco Precautionary Principle Ordinance links the use of an alternatives assessment with transparency and public process. The Precautionary Principle Ordinance calls on a product’s proponents, such as chemical manufacturers, to provide complete information about the impacts of the product so that robust comparisons can be made and regrettable substitutions avoided. In addition, it declares that the most protective decisions result when the general public, or those most affected by a choice or an action, play a role in selecting the range of alternatives considered and the preferred alternative selected. This public process is especially important in cases where scientific uncertainty or missing data renders the decision less readily quantifiable.

San Francisco’s implementation of the Precautionary Principle has resulted in a practical and effective decision-making process incorporating an alternatives assessment approach. The policies resulting from this approach have led to the reduction of toxic chemicals in commerce, whether they are used in city operations or in products and services offered in local stores and businesses.

### **SAFER PRODUCTS THROUGH LOCAL INCENTIVES**

Perhaps the strongest driver for change in product formulation is the marketplace. When consumers demand a less toxic product, industry is usually willing and eager to meet that demand. Local governments have tremendous purchasing power and so can send important signals to the market regarding the need for safer alternatives. San Francisco spends upwards of \$700,000,000 a year in the procurement of products and services. Thus, when San Francisco included health

and environmental criteria within its bid specifications, companies were quick to offer alternatives to the traditional fare.

To institutionalize this procurement philosophy, San Francisco adopted the Precautionary Purchasing Ordinance in 2005, which requires city departments to buy certain products from a list of “approved alternatives” established by the Department of the Environment [23].

This ordinance was influenced by San Francisco’s long experience with environmentally preferable purchasing, and also by the experience of public agencies in Seattle (WA), Santa Monica (CA), and the state of Massachusetts, for example. The ordinance has in turn served as a resource and a model for other like-minded government entities across the country [24].

### **Pressure-Treated Wood**

The selection of the least toxic pressure-treated wood for use in city playgrounds, piers, fences, and other outdoor applications serves as an excellent example of precautionary purchasing. Pressure-treated wood purchased by San Francisco was traditionally infused with the wood preservative, chromated copper arsenate (CCA). Measurements in several city parks revealed that the arsenic, which is a known human carcinogen [25], was leaching out of the wood and into sandboxes. Once on the surface of the wood or in the sand, the arsenic was available to end up on the hands and in the mouths of the young children who frequented those playgrounds. San Francisco was not unique in the use of arsenic-treated wood to construct outdoor play equipment [26], for this use of arsenic treated wood was, at that time, legal and met risk assessment standards set by the federal government. Once the leaching data were made available, the fact that it was perfectly legal to build play structures out of arsenic-treated wood did little to allay the concerns of the public and elected officials about the potential for harm in the long run.

It was impossible for city staff to prove that playing on these structures would lead a child to develop cancer some 30 years later, yet decision-makers determined it was important to take action to prevent harm. An alternatives assessment was performed comparing the impacts, costs, and efficacy of each available wood preservative [27] to determine if safer alternatives could be identified. The alternatives assessment revealed that for a significant majority of the applications of pressure-treated wood, arsenic was not a necessary ingredient and safer alternatives were readily available (e.g., copper-based compounds such as copper boron azole).

An exception to the determination that arsenic is *not* the safest alternative offers an interesting illustration of the robustness of the alternatives assessment approach. Careful examination of a wide array of leaching studies indicated that wood treated with arsenic was actually the least harmful alternative in marine ecosystems. For marine organisms, copper is of greatest concern, not



arsenic [27]. The arsenic appears to keep the copper bound more tightly to the wood and so greatly decreases the amount of copper entering into the seawater. As a result of this alternatives assessment, the Port of San Francisco continues to use arsenic-treated wood for pilings and pier supports. Thus a precautionary alternatives assessment did not lead to an automatic ban of a chemical or a product; the determination of the safest choice is necessarily done on the basis of specific applications.

There are many other examples in which San Francisco used a precautionary approach in the selection of goods and services including pest control products and techniques, computers, lighting, disinfectants, and janitorial supplies [23]. In each case, staff worked closely with end-users to ensure product efficacy, purchasing agents to ensure comparable cost, and the public to ensure that a wide range of alternatives were considered. San Francisco is not the only large institutional purchaser interested in safer products and services; governments, universities, and corporations across the country are using their purchasing power to send signals to the marketplace that the principles of Green Chemistry and alternatives assessment can be translated into safer products [28].

### **Professional Garment Cleaning**

San Francisco's assessment of the chemicals used in professional garment cleaning (i.e., dry cleaning) provides an example whereby local government can reach beyond the range of its own contracting and procurement process and incentivize local businesses to move toward less toxic products and services. This project also provides a telling example of the challenges faced in completing an analysis when the federal government allows chemicals on the market with incomplete testing or hazard information.

The State of California recognized the significant toxicity of the traditional chemical solvent used in professional garment cleaning when it moved to phase out the use of perchloroethylene (perc) by 2020 [29]. San Francisco noticed the proliferation of garment-cleaning shops claiming environmental attributes as those shops began to purchase substitutes for the older perc machines. A number of technologies surfaced to replace perc-based systems including systems using hydrocarbon-based solvents, carbon dioxide, siloxane, or water. In order to make a scientifically defensible recommendation to local businesses regarding the technology that would best minimize harm, San Francisco conducted an alternatives assessment of the various garment-cleaning technologies available on the market.

As part of the alternatives assessment, a number of hazard characteristics—such as carcinogenicity, harm to reproductive or nervous systems, use of volatile organic compounds, and water use—were selected to compare the various solvent alternatives. Very early on in the process of comparing alternatives, the challenge of missing information or “data gaps” became apparent. Although city



staff and consultants assembled the initial analysis, they were not equipped to use complex computer simulations to fill in the missing information. Thus we were pleased to partner with the State of California Office of Environmental Health Hazard Assessment (OEHHA), which has a staff of trained toxicologists and epidemiologists. As a result of the joint effort, an alternatives assessment was finalized that compared not only health and environmental attributes, but also compared permit requirements, fees, and the costs of purchase and installation for each solvent alternative [30]. The analysis revealed that the clear choice to minimize harm at a comparable price was professional wet cleaning, which uses specialized washers and dryers that control revolutions, temperature, and moisture content of the clothes. Wet cleaning can be used for any clothes typically sent for dry cleaning.

This comprehensive analysis became the justification for San Francisco's incentive program to promote wet cleaning technology. At first there was great fear and resistance in the local business community regarding this new approach to garment cleaning. Scientific comparisons alone were not enough to drive the market, and nearly a year went by without any businesses changing over to wet cleaning. The City then partnered with the State of California Air Resources Board and the Bay Area Air Quality Management District to offer garment cleaners a grant that amounted to almost 50 percent of the cost of the wet cleaning equipment. Wet cleaners were also offered hands-on demonstrations and training in Chinese and Korean on the wet cleaning equipment, as well as outreach and promotional resources to help market their services to the general public. The result of this multi-faceted approach was the creation of 10 wet cleaning locations in San Francisco, with more expected to open as demand begins to grow and the deadline to switch out perc machines approaches. The impact of this effort is being felt beyond the borders of San Francisco and Los Angeles (where Occidental College's Pollution Prevention Program has been promoting wet cleaning for more than 10 years). With the leadership of scientists at the Institute of the Environment and Sustainability at the University of California Los Angeles, garment cleaners from around the region attended the demonstrations and trainings held in San Francisco, and wet cleaning technologies are now being adopted across California [31].

### **SAFER PRODUCTS THROUGH LOCAL MANDATES**

Local governments also have the opportunity to drive the market toward the adoption of safer alternatives through legislation. While it is clear that state and the federal bodies have the largest potential impact through the statutory process, it is not uncommon for cities and counties to kick-start legislation using their local authority. Except in cases of specific preemption by federal or state law, cities and counties in the United States have the legal authority to adopt laws that protect the health, safety, and welfare of their residents. In fact,

local governments frequently serve as the “laboratories” or testing grounds for new policies and environmental initiatives. Examples in California of policies that moved from the local level to the state level include: smoking bans in restaurants, bans on the sale of mercury-containing fever thermometers, disclosure of mercury in lighting equipment, restrictions on the use of pesticides in public spaces, green building codes, and many more. Recently, San Francisco has utilized its legislative authority to adopt two laws that may affect the way products are designed or used—one through an outright ban and the other through the requirement to provide information at the point of sale.

### **Phthalates in Children’s Products**

In 2006, San Francisco followed the lead of the European Union and became the first entity in the United States to ban the sale of children’s products that contain any of six types of phthalates [32]. Phthalates, used as an additive to make PVC plastic soft and pliable, were commonly found in children’s toys and other products. Europe had first banned these chemicals from use in children’s products in 1999 after concerns that small concentrations of the chemicals could leach out of the products and disrupt development of young children [33]. The European ban was re-evaluated and then strengthened in 2005 [34]. Like the European Union, San Francisco used the lens of the Precautionary Principle to look at alternatives and determined that phthalates were not inherently necessary in the manufacture of children’s toys. After its local ban went into effect, San Francisco began implementation by educating retailers and setting up testing and enforcement protocols. However, when the State of California adopted a similar ban, the City was able to rescind its local law [35]. A few months later, a ban on phthalates in children’s products based on the findings and language first developed in San Francisco was passed and signed into law by the United States Congress [36]. Thus, a local government can use its legislative authority to drive the adoption of Green Chemistry principles and mandate the use of safer alternatives well beyond its immediate borders.

### **Cell Phone Radiation**

There are instances where a local government has very limited authority to change the way products are designed or evaluated for safety, but can still play a critical role in raising the profile of an issue. Such was the case when San Francisco investigated the issue of cell phone radiation. In this case, the United States Federal Communications Commission has the full authority to regulate cell phones and determine the maximum allowable levels of radiation that can be absorbed by the body and/or head of a cell phone user. San Francisco’s Precautionary Principle Ordinance stresses the importance of acquiring complete and accurate information about a product as a way to help consumers make informed decisions. It was this emphasis on the importance of information

and “right to know” that led the Mayor and Board of Supervisors to pass a first-in-the-nation law that requires retailers of cell phones to post the maximum radiation levels absorbed by the head or body next to information on price and other features. The law, called the “Cell Phone Right to Know Ordinance” also requires that retailers provide supplemental information at the store to inform consumers about ways to reduce their exposure to cell phone radiation [37]. San Francisco’s Cell Phone Ordinance helps consumers to do their own “alternatives assessment” and make informed decisions about the products they select for themselves or for their children.

## CONCLUSION

Forced by a lack of effective regulatory action at the state and federal levels, cities such as San Francisco have developed innovative solutions to address the myriad issues presented to us by the use of toxic chemicals in commerce. We will continue to pilot and implement precautionary policies aligning with the principles of Green Chemistry to drive the redesign of products and services. Such efforts may be the only way out of the ever-growing costs of financial investments in disposal, cleanup, and ultimately the treatment of health impacts. Under the umbrella of San Francisco’s Precautionary Principle Ordinance, city decision-makers utilize a wide array of tools from incentives to mandates that are based on alternatives assessments and seek to minimize the use of toxic chemicals, identify safer alternatives, and ensure that decisions are both robust and practical. As we employ these real-world applications of Green Chemistry principles, we find that we’re not just digging ourselves out from under the undue challenges of toxic chemicals; we’re also building the foundation of a safe chemicals future.

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