

## **Environmental Topic**

Emerging Waste Streams

## **Proposed Project Title**

Circularity Principles and Green and Sustainable Chemistry Considerations for Emerging Waste Streams

## **Project Deliverables**

Deliverables for this project will include a web-based Technical and Regulatory Guidance Document and an online webinar training series. Elements would include:

1. Summarize the concepts of green chemistry and circularity with leading references and resources.
2. Develop concurrence around the principles of green chemistry and circularity.
3. Provide a summary of current state and federal regulations and programs related to green chemistry (for example, CA, WA)
4. Develop a framework that considers the intersection of green chemistry, materials management, and circularity for contaminants and toxic chemicals, as well as cross-collaboration between green chemistry professionals and waste/remediation professionals.
5. Present case studies including examples of current best practices and opportunities to build on them.
6. Provide links to resources and databases.
7. Identify data gaps and needs to ensure success of sustainable alternatives selection with waste minimization.
7. Develop an online webinar training series to support the Technical and Regulatory Guidance.

## **State Team Leader(s)**

Team Leaders will be sourced for interest by ITRC.

States active in this topic area CA, MA (TURI), MN, NY, VT, WA.

State supporters were identified for the proposal and are included in the Additional Information section.

## **Proposal Contacts**

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## Problem Statement

USEPA defines green chemistry as the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal. The National Science and Technology Council (2023) and ECOS (2023) have also developed definitions, recognized leading principles, and published strategic plans for sustainable and green chemistry at the Federal and State-levels. Several states, such as CA, MN, ME, MI, OR, VT, and WA, have adopted toxics reduction and green chemistry policies and legislation over the last 15 years, or more. As an example, the California Green Chemistry Law started the Safer Consumer Products Program; it has a broad scope and applicability in terms of products and chemicals. However, some of the other state policies and laws tend to focus on particular chemicals, products, or industries and vary in their targets and intention. Materials management policies often focus on diverting materials from the landfill for recycling without much attention to the presence of toxic chemicals.

With the advent and growing understanding of emerging contaminants, several states have gone broader and have developed bans across classes of chemicals (for example, PFAS and halogenated flame retardants) in either specific priority products or a range of products. While these restrictions are moving the focus to the production using toxics, there has been a lack of focus on toxic impacts from materials being reused or recycled into new products. There is also lack of focus on the disposal of the majority of these products.

Other legislation and/or proposed bills have ranged from restrictions on toxic flame retardants in furniture, children's products, and/or electronics, to restrictions on other chemicals of concern including cadmium, bisphenols, mercury, phthalates in specific product types such as children's and pet products, receipt paper, and food containers.

Focus on banning individual chemicals or classes of chemicals in consumer or business products at a state level has led, in some cases, to an intensive administrative burden for implementation and compliance for both the states as well as those along the supply chain, from primary producers to manufacturers and retailers. In addition, it has emphasized the need for addressing contaminants at the end of the original products' life. Although addressing hazardous substances in products is essential, the financial burden on the states and across the supply chain to address these chemicals, as well as waste management and remediation issues that are the result of banned chemicals, is significant. For example, Ling (2024) estimates current costs to remove and destroy the total PFAS mass released annually into the environment would likely exceed the global GDP of 106 trillion USD. Ling (2024) identifies that this level of treatment is not technically or economically achievable, and highlights the unaffordability of using environmental remediation alone to manage environmental PFAS stocks. Without significant reductions in production and emissions, the mass of PFAS and other hazardous substances present in the global environment will continue to rise. Ling's paper emphasizes both the difficulty in relying on remediation alone to address the issue as well as the importance of state and federal government focus on addressing PFAS in products.

These concerns are timely and of utmost importance as circularity gains momentum at the state level. The principles of circularity which include i) designing out waste and pollution; ii) keeping products and materials in use; and iii) regenerating natural systems (avoiding the use of non-renewable resources and preserving or enhancing renewable ones), are essential in considering the broader context of the entire issue from production to waste management. The sheer volume of products containing hazardous substances and requiring disposal, along with the amount of contaminated media resulting from remediation of hazardous substances in the environment, far exceeds the capacity of the approved disposal and destruction options available. Additionally, transforming our system from a linear (take-make-use-waste) to a circular (take-make-use-reuse-recycle-repair-remanufacture-waste) system results in the toxics in the original product remaining in the system. Continued use and reuse of toxics is an issue deserving more attention and work toward solutions.

As toxic reduction and green chemistry continue to gain momentum along with efforts to enhance circularity, states have a unique and timely opportunity to evaluate current toxic reduction and green chemistry frameworks, reuse and recycling systems, harmonize approaches, and define and incorporate circularity efforts to leverage and ensure impactful actions and outcomes. The opportunity to support and encourage changes upstream that remove chemicals of concern (including feedstocks, intermediates, and process chemicals) in supply chains and share best practices in materials management that handle materials and waste streams with chemicals that have been addressed in product laws would greatly benefit the environmental community by reducing remediation burdens for chemicals released to the environment.

## Additional Information

Supporters of this proposal:

Al Innes, Safer Product Chemistry Coordinator, Minnesota Pollution Control Agency  
Peder Sandei, Minnesota Pollution Control Agency  
Saskia van Bergen Safer Chemist Lead, Washington State Department of Ecology  
Kara Steward, Solid Waste Program, Washington State Department of Ecology  
Simona Bălan, California Department of Toxic Substances Control, Safer Consumer Products Program  
Topher Buck, California Department of Toxic Substances Control, Safer Consumer Products Program  
Melanie Johnson, Wisconsin Department of Natural Resources  
Rui Resendes, Change Chemistry

The team for this project would work to collaborate with and leverage organizations that are currently working in green chemistry and circularity such as the Interstate Chemicals Clearinghouse (IC2), Change Chemistry, Safer States, and other organizations, to make information available about best practices and to overcome barriers to implementing green chemistry and circularity principles at all levels. IC2 is a program of the Northeast Waste Management Officials' Association (NEWMOA) convenes state, local, and tribal governments with businesses, researchers, and nongovernmental organizations to promote the development and use of safer chemicals and products for a clean environment, healthy communities, and a vital economy. Change Chemistry is a non-profit collaboration of more than 100 members across the supply chain and state regulatory community that aims to make safer and sustainable chemistry widely available in the marketplace. Safer States is a national alliance of environmental health organizations and coalitions from across the nation working to safeguard people and the planet from toxic chemicals, and to ensure availability of safer solutions for a healthier world.

Examples of opportunities to support and encourage changes in products and processes would be included in this project through discussion of best practices and case studies. In addition, compiling information to identify where and how waste can be most efficiently managed such that products are evaluated both from hazardous chemical reuse as well as hazardous chemical removal/destruction and beneficial reuse of other portions of the products. The knowledge and experience from the waste, toxics, and remediation program professionals typically represented in ITRC teams, and other environmental professionals, could be connected to support collaboration across environmental programs. An important goal of the team would be to identify how to implement green chemistry and circularity principles in an integrated way across the lifecycle without creating new problems.

References:

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USEPA Circular Economy Home Page. <https://www.epa.gov/circulareconomy>

USEPA Green Chemistry resources. <https://www.epa.gov/greenchemistry>