



Northwest
Green Chemistry

Emerald Corridor Green Chemistry & Engineering Roadmap 2018–2023

Goals & Recommendations for Collective Impact



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Executive Summary

The *Emerald Corridor Green Chemistry and Engineering (GC&E) Roadmap 2018–2023* is intended to aid communication, coordination, action, and evaluation of green chemistry and engineering initiatives in the Emerald Corridor (Vancouver, BC to Portland, OR) region. Expected outcomes of its implementation include improved environmental and human health, increased incentives for green chemistry and engineering business innovation, the creation of supporting local and state policies, integrated curricula, greater equity, better educational opportunities, and further professional development. This document represents the efforts of nonprofits, government agencies, businesses, universities, and advocacy groups to update the *Roadmap for Green Chemistry in Washington State, 2012–2017*. Without the generous donation of their time and expertise, this document would not exist.

The creation of Northwest Green Chemistry (NGC) was an outcome of recommendations from the 2012–2017 Roadmap. NGC was tasked with updating and expanding the 2012–2017 Roadmap by broadening the geographic scope (Vancouver, BC to Portland, OR), including green engineering and sustainable chemistry, and encompassing environmental and social justice concerns. While the Emerald Corridor is the focal point for action, we drew

inspiration and guidance from the work of individuals and organizations in the broader region, some of whom have been national or international leaders in GC&E for many years. In this document, we outline the resulting goals and recommendations and provide relevant metrics.

Our goals in creating a Roadmap were to facilitate a shared vision, create common goals, recommend considerations in achieving those goals, and provide metrics to measure progress. It was clear from the process that, together, we need to increase awareness of the positive impacts of green chemistry and engineering choices. We hope that you use this document within your organizations to enhance or create strategies to address the focus areas and attendant goals. More than that, we need to share this with parties that can influence legislation, provide funding, or otherwise support the collective work. Together, we can attract other interested parties, demonstrate success through outcomes, and create incentives and tools that integrate GC&E principles into our institutions. Together, through cooperation and coordination, we will increase the resilience of the region, improving the lives of people living in the Emerald Corridor while conserving its natural beauty.



Process and Scope

Northwest Green Chemistry (NGC) began the Roadmap revision process by benchmarking progress made on the *Roadmap for Green Chemistry in Washington State, 2012-2017* through research and interviews. We then supervised a University of Southern California, Sol Price School of Public Policy Capstone team of graduate students to conduct a scan of green chemistry and engineering (GC&E) initiatives in the Emerald Corridor. The Emerald Corridor, defined by the Bullitt Foundation, is the region bounded by Vancouver, BC to the north, Portland, Oregon to the south and the Cascades to the east. The Capstone team spent months researching the GC&E policy and funding landscape, interviewing key stakeholders, and performing an analysis. The Capstone research helped to expand the network of collaborators, highlighted important considerations, and informed goals and metrics. Building on this work, NGC facilitated a series of three webinars, supplemented with interviews, to obtain input from a diverse range of interested parties. The calls were recorded and can be accessed at NGC's website. All goals and recommendations were formulated from these calls and interviews and represent the vision of the larger community.

The goals and recommendations are grouped into six focus areas: 1) Education; 2) Research; 3) Policy; 4) Business and Economic Development; 5) Communication

and Outreach; and 6) Environmental and Social Justice. While the goals and recommendations are intentionally general in the Roadmap, they easily become specific when groups implement them. For example, by specifying deadlines, organizational leaders, and targets, the recommendation, "GC&E will be integrated into K-12 curricula statewide and meet existing science content standards" becomes, "By [2021], [Education Group] will integrate GC&E into [20%] of [middle school curricula statewide]."

Environmental and Social Justice

Within the Emerald Corridor, as in all regions, there are low-income populations, disadvantaged communities, immigrant groups, vulnerable populations, and limited English-speaking communities. The recommendations in this Roadmap are designed to encourage targeted support for these communities, increase their engagement, and amplify their voices where they desire change.

Historically underserved populations are more frequently exposed to environmental hazards and chemicals of concern than those in affluent communities. This contributes to disproportionate health impacts, higher healthcare costs, and a continuing cycle of needless barriers to the best quality of life. These disparities occur in many forms, such as limited funding in school systems where GC&E

curricula could otherwise be implemented. This could ultimately hinder the diversity of professionals in the field, limiting our collective perspective and ability to solve problems. The disparity also occurs in consumer products and in building materials, where the most economical options may increase exposures to harmful chemicals. There are many more examples of these disparities that provide opportunities for sustainable innovation and greater environmental and social justice.

One goal of this Roadmap is to develop initiatives and training that improve understanding of these disproportionate impacts. To create accessible, practical solutions, GC&E practitioners must be inclusive of the stakeholders who are impacted.

Circular Economy

The Circular Economy is a departure from the traditional economy in which materials are extracted, processed into goods that are used by a consumer, and then disposed of in a landfill or incinerator or leaked into the environment. According to the [Ellen MacArthur Foundation](#), a circular economy “aims to redefine growth, focusing on positive

society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems”

Circular products fulfill the three principles outlined above. They subsequently preserve natural capital and promote human and ecosystem health across the product life cycle. Eliminating toxic chemicals in products and processes is essential to a circular economy. Toxic substances in products can result in increased risk to those who manufacture, use, and recycle materials. Eliminating hazardous chemicals from products and processes can help to maintain the purity and quality of recycled materials. Higher-quality materials allow for higher-value uses that grow a circular economy. A circular economy requires the application of GC&E principles.





Goals & Recommendations

Focus Area One: Education

VISION

GC&E education ensures sustainability solutions that are well designed and broadly implemented. Improved access to GC&E training and resources mean students and employees are equipped to meet sustainability challenges. A workforce with knowledge of GC&E builds the capacity to implement sustainability solutions. To increase equity, GC&E training and internship programs will have clear diversity, equity, and inclusiveness goals.

GOALS & RECOMMENDATIONS

- GC&E will be integrated into K-12 & university curriculum throughout the Emerald Corridor by meeting existing science content standards.
 - To increase equity in education, GC&E training for educators working in financially disadvantaged school districts will be free, while educators working in financially advantaged school districts will be charged a fee.
- Groups of educators, experts, and advocates will network and organize to apply for grants.
- Educators will target university classes for GC&E integration including chemistry, biology, biochemistry, environmental sciences, and engineering (particularly environmental, chemical, and civil engineering).
- Existing regional and national GC&E educational initiatives will be adapted locally (e.g. [Green Chemistry Education Roadmap](#)).
- Internship and practicum programs will connect higher education students to opportunities to practice GC&E in businesses, nonprofits, and government agencies.
 - Institutions will help students connect their educational outcomes to employment opportunities in GC&E.
 - Diversity, equity, and inclusiveness objectives will inform these programs.
 - Organizations will coordinate and apply for funding for internship programs from federal and state grants, foundations, businesses, and industry associations.

- Professional development training providers will incorporate GC&E into their offerings.
 - An up-to-date list of existing training for local, regional, and state source control professionals and pollution prevention professionals will be created.
 - Businesses, nonprofits, government agencies, and research labs actively engaged in GC&E will develop relationships with educators to create regionally relevant curricula that will heighten engagement at schools and at work.
 - Businesses will include GC&E professional development in relevant job listings and descriptions (e.g. chemical hazard assessment, alternatives assessment, toxicology for chemists, and relevant certificates).

METRICS

- Number of teachers integrating GC&E into curricula
- Number of teachers, schools, and departments that have committed to integrating green chemistry by signing the [Beyond Benign Green Chemistry Commitment](#)
- Amount of funding received to integrate GC&E into education
- Number of course syllabi (K-12 and university) recommending textbooks or online resources that focus on or incorporate GC&E
- Number of regional faculty attending and presenting at GC&E conferences, or on GC&E topics at other conferences
- Number of schools and individual teachers with a public commitment to GC&E
- Number of internships available in GC&E
- Amount of funding received for GC&E internship programs
- Number of job descriptions requiring GC&E skills
- Number, quality, and depth of GC&E professional development opportunities

Focus Area Two: Research

VISION

A cohesive and diverse community of GC&E practitioners is necessary to build a strong, unified case for advancing GC&E research and securing funding. Therefore, it is necessary to identify a core set of equity and sustainability-related issues, for which GC&E may contribute solutions to support a long-term, common vision. Research and development will focus on identifying and creating alternatives to the most impactful chemicals of concern by addressing those products and processes that pollute stormwater, air, and sewage treatment plants the most.

GOALS AND RECOMMENDATIONS

- Develop a ubiquitous call for ongoing research funding for critical issues.
 - The intersection of recycling and the contamination of recycled material streams will be examined.
 - Innovative methods of using local waste (e.g. agricultural or municipal) as a feedstock material will be prioritized.
 - Frameworks and tools will be developed to create sustainable materials and products and to avoid regrettable substitutions.
 - Economic impact will be a component of studies on green and sustainable technology.
- Intersectoral collaboration will lead to more circular product design.
 - Circular product design will require collaboration across the supply chain between businesses, trade associations, government organizations, academia, and non-profit organizations.
 - Local governments will pilot work with constituents to identify one critical sustainability issue and create a collaborative to address it.
 - Collaborators will foster ongoing community engagement to help address future issues.
 - Collaborators will develop a shared understanding of criteria that define circular products.
 - Collaborators will create and distribute business case studies to raise awareness of GC&E's role in the circular economy.

- Aspirational GC&E research goals and entrepreneurship will be funded through financial and other incentive programs.
 - Broadly publicize competitions with a large reward for GC&E innovations
- Frameworks and tools will be developed to consistently identify safer alternatives, increase their adoption, and avoid regrettable substitutes.
 - Collaborators will share methods for identifying safer alternatives such as certifications and tools for assessing hazard, exposure, and life cycle impacts.
 - Publicly accessible resources will be created to facilitate sharing information on safer alternative chemicals, materials, and products.

METRICS

- Amount of research funding for GC&E, particularly for priority issues and circular product design
- Number of academic labs focusing on priority issues and circular product design
- Number of publications from regional labs on priority issues and circular product design
- Number of patents filed by regional labs, businesses, or others related to solutions to priority issues and circular product design
- Number of undergraduate and graduate students trained in academic labs that incorporate GC&E principles



Focus Area Three: Policy

VISION

Governments within the Emerald Corridor are recognized for collaborative policies that are aligned to spur innovation, build capacity, and incentivize the uptake of GC&E solutions. These policies benefit manufacturers who go beyond compliance. Policies will be based on ethical principles that support sustainable development.

GOALS AND RECOMMENDATIONS

- Local and state governments will collaborate with policymakers, NGOs, consultants, businesses, and advocacy groups to develop templates for successful policies.
 - Science-based organizations, environmental and social justice organizations, other advocacy organizations, and academia will collaborate to inform policymakers.
 - Policies will be shared between communities to align GC&E policies across the region.
 - Policies will provide direction to the market to encourage investment in R&D to meet upcoming requirements.
 - Government Requests for Proposals will prefer products that are third-party verified for GC&E attributes, and organizations and services that employ standards and/or certifications based on GC&E principles.
 - Economic impact studies will be distributed to key policymakers and business leaders to highlight the economic development potential of GC&E.
- A system to rapidly identify and address emerging hazards will be developed to prevent harm to human and environmental health.
 - Elected officials will work with government agencies and non-profit organizations to enact new regulations as needed to address emerging hazards.
 - Government agencies, such as those responsible for hazardous waste and permitting, will consider how to incorporate emerging hazards into existing regulations and procedures.
 - Local governments will work with experts in social and environmental justice to implement solutions grounded in GC&E principles and policies that reduce health disparities.

- Governments in the Emerald Corridor will establish their regions as prime locations for manufacturers using GC&E principles.
 - Policymakers will work directly with businesses to ensure new business incentives are the most effective for driving GC&E innovation.
- Local officials will be more aware of the importance of GC&E for the health and safety of their constituents.
 - Intervention strategies will focus on local-level government as the most responsive, flexible, and open to policy changes.
 - Local governments may use a combination of tax preferences, zoning decisions, and other methods to incentivize and encourage the application of GC&E principles.
- Policy analysts will clearly state ethical considerations underlying policy recommendations.
 - Note specific principles addressed (precaution, fairness, transparency, accountability, effectiveness, justice, participation, etc.).
 - Analysts will also indicate if stakeholders were considered in policy creation, revision, and implementation.

METRICS

- Number and types of readily-available and aligned policy templates at the local, county, regional, state, and cross-jurisdictional levels
- Level of policy enforcement/severity of non-compliance consequences
- Number of GC&E-specific policies implemented within the Emerald Corridor
- Number of policies that specifically address disadvantaged and vulnerable communities
- Number of environmentally preferable purchasing policies (particularly those aligned with each other)
- The amount of government spending on environmentally preferable products
- Number of design for deconstruction, right to repair, and take-back policies



Focus Area Four: Business and Economic Development

VISION

The Emerald Corridor is a welcoming region for businesses with robust sustainability practices through coordinated incentives designed to motivate businesses to locate in Oregon, Washington, and British Columbia. The region assists existing local businesses to improve their sustainability practices. Sustainability attributes are considered holistically, addressing the health of consumers, workers, neighbors, and the environment.

GOALS AND RECOMMENDATIONS

- NGOs, businesses, governments, industry associations, and academic institutions will implement environmentally preferable purchasing (EPP) policies.
 - Develop a sustainable procurement template to align procurement policies within the Emerald Corridor and provide clear market direction.
 - Reframe procurement narratives to include consumer health as part of performance so that toxic products are disallowed.
 - Reward design for deconstruction and right to repair businesses.
- Certifying organizations and standards-setting entities will provide leadership in standards development and support procurement that is aspirational and includes multiple sustainability goals.
- Collaborations with certification bodies will exchange information to improve adoption of EPP policies and overcome challenges to implementation.
- Identify positive, not only negative or restricted lists, of chemicals and products.
- Work with certifying organizations and standards-setting entities to develop an easy-to-use database of product information that correlates to shared procurement standards.
- Request full transparency of chemicals in products as well as chemicals used or generated in manufacturing and recycling processes for those products.
- Provide a summary of both individual attribute and overall sustainability scores to satisfy purchasers' unique priorities.
- Prioritize chemical substitution by building on existing Restricted Substances Lists and chemicals of concern to protect air, water, and land. Set targets to incrementally reduce them over time. Guide manufacturers and designers to prioritize those chemicals that pose the greatest risk.



- Work with manufacturers to identify hazardous chemicals for which there are currently no alternatives available. Build collaborations to design and develop safer alternatives.
- Work to incorporate social impact evaluations into GC&E procurement policies.
- State and local governments and industry associations will provide GC&E incentives and support to all businesses at all stages of development.
 - Provide financial and infrastructure support for disruptive innovations created by small businesses for successful development of GC&E solutions.
 - Existing clean energy funds will include GC&E objectives in awards.
 - Provide small businesses with additional support as needed in managing hazardous substances.
- Businesses and industry associations will partner with online retailers to apply product search algorithms that incorporate GC&E into search result rankings.
- Governments will leverage Departments of Commerce to identify business incentives (financial, equipment, etc.) for GC&E and publicize them widely.
 - Governments will provide a single point of contact to streamline information on incentive programs and application procedures.

METRICS

- Number of applicants and incentive funds awarded
- Number of EPP policies implemented
- Amount of hazardous chemicals eliminated from supply streams in relation to the total quantity of hazardous chemicals in use
- Number of products and businesses meeting new government EPP standards
- Number of businesses that meet transparency requirements, e.g. provide full disclosure of all chemical ingredients in support of procurement
- Percentage of state, regional, county, and local government purchases that meet the aligned EPP requirements

Focus Area Five: Communication and Outreach

VISION

Consensus on the value of advancing GC&E in the region shifts individual organizational work toward cooperative efforts to achieve common goals. Communication of these goals reaches new audiences to increase collective impact.

GOALS AND RECOMMENDATIONS

- GC&E groups will communicate with a broad audience to build awareness.
 - Communications will include information about relevant disparate health outcomes and how community members can advocate for change.
 - Groups will ensure these communications reach target audiences which may require developing resources in multiple languages.
 - Communications will be simple, direct, and tailored to the audience.
 - Communications will give consumers the ability to make informed decisions.
 - Develop partnerships with experts in outreach and communications.

- Communications will tell compelling stories to illuminate how groups working on GC&E policies and programs overcame challenges to create positive outcomes.
- Communication will be reciprocal to include stakeholder insights.
- Groups will work together to support a more cohesive messaging strategy and broader reach over time.
- GC&E-focused groups will build connections with organizations working toward related goals to optimize resources, synchronize messaging, and avoid duplicating efforts.
 - Networking strategies will set clear targets to include organizations addressing climate change, sustainability, public health, unions, and those representing vulnerable or disproportionately impacted populations.
 - GC&E groups will network with non-GC&E professionals outside of GC&E-centric meetings.
 - Local meetings and roundtables will build resources and tools among people and organizations with shared goals.
- Local governments will communicate the influence of GC&E on community resilience, especially to public safety departments.
- Manufacturers and retailers will gain increased knowledge about sustainable products and sustainable product design.
 - External groups will clearly communicate demand for sustainable products.
 - External groups will assist manufacturers and retailers in developing and/or finding supply to meet demand.
 - Industry associations will play a vital role in advancing sustainable products.
- Organizations will create and disseminate communications that investigate and report on how business implementation of GC&E policies leads to cost savings, employee satisfaction, and improved brand perception.
- Groups will report progress when restoring environmentally degraded areas where disproportionately impacted communities live, work, and play.



METRICS

- Number of public adoption/statements of support for the GC&E Roadmap
- Number and resilience of collaborations resulting from the Roadmap
- Number of people reached through communications
- Diversity, breadth, and strength of networks

Focus Area Six: Environmental and Social Justice

VISION

Embedded within the Emerald Corridor are people with critical perspectives and ideas that will advance GC&E and improve outcomes for all. By prioritizing diversity, equity, and inclusion, the GC&E field flourishes and is more resilient. Through direct support and collaboration with impacted groups, GC&E is more responsive, relevant, and responsible to the community.

GOALS AND RECOMMENDATIONS

- Environmental and social justice training will be provided to all employees.
 - Organizations will work with professionals to provide high quality environmental and social justice training. Employee training will include a framework for identifying and analyzing equity impacts.
 - Training and outreach will address the potential unintended negative consequences of GC&E solutions that may at first appear to be beneficial for all.
- Groups will provide inclusive pathways to GC&E employment and careers and ongoing support.
- Organizations will use frameworks such as the [Racial Equity Toolkit](#) from Seattle City Light to integrate environmental and social justice in systems and in the planning phases of projects.
 - The system will include a process for identifying and addressing unintended negative environmental and social justice consequences on communities.
 - Demographics will be disaggregated to demonstrate health disparities or disproportionate impacts.



- Evaluation will measure outcomes of environmental and social justice initiatives and will be reported to interested parties. Social scientists and impacted communities will be engaged to develop clear metrics for progress.
- Grantmaking agencies will show preference in funding groups that have accounted for environmental and social justice in their project plans.
 - Funding organizations will prioritize projects where GC&E can provide solutions that also address environmental and social justice challenges. Examples include (but are not limited to) exposure to toxic chemicals in farm and forestry work, beauty salons, use of personal care products, and dry cleaners.
 - Funding organizations will prioritize projects that include impacted communities in data gathering and decision making.
 - Conversely, applicants and bidders will prioritize applications to foundations and other funding organizations that value environmental and social justice.

METRICS

- Adoption rates for environmental and social justice initiatives
- Improvement in individual and cumulative health outcomes (measured in life expectancy) of impacted communities (both absolute and in comparison with neighboring communities)
- Decrease in exposure to hazardous chemicals and in hazardous chemical loading over time for disproportionately impacted communities (both absolutely and in comparison with neighboring communities)
- Number of environmental and social justice trainings provided
- Diversity of employees, managers, leaders, collaborators, researchers, and constituents
- Amount of resources provided to increase equity, diversity, and inclusion
- Percent change in the total amount of grants designated for GC&E projects that have explicitly stated outcomes around increasing equity, diversity, and inclusion





Next Steps

The goals and recommendations presented in this Roadmap build on a number of resources that are available on [Northwest Green Chemistry's website](#). Resources include the USC Price Capstone team research summaries, progress benchmarks on the recommendations from the 2012–2017 Roadmap, and the webinars. The website also provides implementation resources and opportunities to engage in workgroups. In the implementation phase, we are reminded to involve impacted parties in decision-

making and that prevention is the key to a brighter future. To increase capacity for change in the region we will work together. The *Emerald Corridor Green Chemistry and Engineering Roadmap 2018–2023*, realized through the power of collaborative action, can address complex environmental challenges and improve the economy of the region. Every plan is only as good as its implementation, evaluation, and, ultimately, its outcomes. We stand ready to create a better, more sustainable, future today.



Northwest Green Chemistry enhances human and environmental health by fostering innovation and economic opportunities through sustainable and green chemistry and engineering solutions.

PHOTO CREDITS

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