



Green Chemistry Challenge Awards Program:

Nomination Package for 2020 Awards



Closing Date: December 31, 2019

An electronic version of this document is available at <https://www.epa.gov/greenchemistry>

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THE GREEN CHEMISTRY CHALLENGE AWARDS promote the environmental and economic benefits of developing and using novel green chemistry. These prestigious annual awards recognize chemical technologies that incorporate green chemistry into chemical design, manufacture, and use.

EPA's Office of Chemical Safety and Pollution Prevention sponsors the Green Chemistry Challenge Awards in partnership with the American Chemical Society Green Chemistry Institute® and other members of the chemical community.

This nomination package contains explicit instructions on how to enter the 2020 competition. **Entries must be sent no later than December 31, 2019.** EPA will present the awards at a ceremony in the summer of 2020.

For a list of prior Green Chemistry Challenge Award winners, please visit <https://www.epa.gov/greenchemistry/green-chemistry-challenge-winners>.

Green Chemistry

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

Green chemistry reduces pollution at its source by minimizing or eliminating the hazards of chemical feedstocks, reagents, solvents, and products. This is unlike treating pollution after it is formed (also called remediation), which involves end-of-the-pipe treatment or cleaning up of environmental spills and other releases. Remediation may include separating hazardous chemicals from other materials, then treating them so they are no longer hazardous or concentrating them for safe disposal. Most remediation activities do not involve green chemistry. Remediation removes hazardous materials from the environment; on the other hand, green chemistry keeps the hazardous materials out of the environment in the first place.

However, if a technology reduces or eliminates the hazardous chemicals used to clean up environmental contaminants, this technology would qualify as a green chemistry technology. One example is replacing a hazardous sorbent [chemical] used to capture mercury from the air for safe disposal with an effective, but nonhazardous sorbent. Using the nonhazardous sorbent means that the hazardous sorbent is never manufactured so the remediation technology meets the definition of green chemistry.

EPA usually presents one Green Chemistry Challenge Award in each award category. For the 2020 competition, there are five award categories.

- Focus Area 1: Greener Synthetic Pathways
- Focus Area 2: Greener Reaction Conditions
- Focus Area 3: The Design of Greener Chemicals
- Small Business* (for a technology in any of the three focus areas developed by a small business)

Introduction

Award Categories

Scope of the Program

- Academic (for a technology in any of the three focus areas developed by an academic researcher)

*A small business for purposes of this award must have annual sales of less than \$40 million, including all domestic and foreign sales by the company, its subsidiaries, and its parent company.

More detail about the three Focus Areas is included below.

To be eligible for an award, a nominated technology must meet the scope of the Green Chemistry Challenge program by meeting each of these six criteria:

1. It must be a **green chemistry technology** with a significant chemistry component
2. It must include **source reduction**
3. Its sponsor must be an **eligible entity**
4. It must have a **significant milestone** in its development within the past five years
5. It must have a **significant U.S. component**
6. It must fit within at least one of the **three focus areas** of the program

1. Green Chemistry Technologies

Green chemistry technologies are extremely diverse. As a group, they...

- Improve upon any chemical product or process by reducing negative impacts on human health and the environment relative to competing technologies
- Include all chemical processes: synthesis, catalysis, reaction conditions, separations, analysis, and monitoring
- Make improvements at any stage of a chemical's lifecycle, for example, substituting a greener feedstock, reagent, catalyst, or solvent in an existing synthetic pathway
- May substitute a single improved product or an entire synthetic pathway
- Benefit human health and the environment at any point of the technology's lifecycle: extraction, synthesis, use, and ultimate fate
- Incorporate green chemistry at the earliest design stages of a new product or process
- Employ a significant change in chemistry, although they may also incorporate green engineering practices

2. Source Reduction

For this program, EPA defines green chemistry as the use of chemistry for **source reduction**.

According to the Pollution Prevention Act of 1990 (PPA), the term "source reduction," also known as Pollution Prevention or P2, means any practice which:

- (i) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and

- (ii) reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants. The term includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

The term does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to and necessary for the production of a product or the providing of a service.

Additionally, the Agency interprets P2 as including practices that reduce or eliminate the creation of pollutants through increased efficiency in the use of water, energy, raw materials, or other resources, or that may protect natural resources through conservation.

Chemical technologies that include recycling, treatment, or disposal may meet the scope of the program if they offer source reduction over competing technologies.

3. Eligible Individuals or Organizations

Companies, individuals, academic institutions (including state and tribal universities and their representatives), non-profit and not-for profit organizations and their representatives are eligible for Green Chemistry Challenge Awards for outstanding or innovative source reduction technologies.

4. Significant Milestone

A green chemistry technology must have reached a significant milestone within the past five years.

Some examples are:

- Critical discovery made
- Results published
- Patent application submitted or approved
- Pilot plant constructed
- Relevant regulatory review (e.g., by EPA under TSCA¹, FIFRA², or CAA³; by the U.S. Food and Drug Administration under FDCA⁴) initiated or completed
- Technology implemented or launched commercially

5. Significant U.S. Component

A significant amount of the research, development, or other aspects of the technology must have occurred within the United States. If the only aspect of the technology within the United States is product sales, the technology may not meet the scope of the program.

6. Focus Areas of the Green Chemistry Challenge

Green chemistry technologies fit into at least one of the three focus areas below. Technologies that do not fit within at least one focus area may not fall within the scope of the program.

Focus Area 1: Greener Synthetic Pathways

This focus area involves designing and implementing a novel, green pathway to produce either a new or existing chemical substance.

Selection Criteria

Examples include synthetic pathways that:

- Use greener feedstocks that are innocuous or renewable (e.g., biomass, triglycerides)
- Use novel reagents or catalysts, including biocatalysts and microorganisms
- Use natural processes, such as fermentation or biomimetic syntheses
- Are atom-economical
- Are convergent syntheses

Focus Area 2: Greener Reaction Conditions

This focus area involves improving conditions other than the overall design or redesign of a synthesis. Greener analytical methods often fall within this focus area.

Examples include reaction conditions that:

- Replace hazardous solvents with solvents that have less impact on human health and the environment
- Use solventless reaction conditions and solid-state reactions
- Use novel processing methods that prevent pollution at its source
- Eliminate energy- or material-intensive separation and purification steps
- Improve energy efficiency, including reactions running closer to ambient conditions
- Reduce greenhouse gas emissions

Focus Area 3: The Design of Greener Chemicals

This focus area involves designing and implementing chemical products that replace more hazardous products.

Examples include chemical products that are:

- Less toxic than current products
- Inherently safer because they reduce the likelihood or severity of accidents
- Recyclable or biodegradable after use
- Safer for the atmosphere (e.g., do not deplete ozone, form smog, etc.)

Nominated chemistry technologies that meet the **scope of the program** will be judged on how well they meet the following three selection criteria:

1. Science and Innovation

The nominated chemistry technology should be innovative and of scientific merit.

The technology should be, for example:

- Original (i.e., never employed before) and
- Scientifically valid, that is, can the nominated technology or strategy stand up to scientific scrutiny through peer review? Does the nomination contain enough chemical detail to reinforce or prove its scientific validity? Has the mechanism of action been clarified via scientific research?

2. Human Health and Environmental Benefits

The nominated chemistry technology should offer human health and/or environmental benefits at some point in its lifecycle from resource extraction to

ultimate disposal. Quantitative statements of benefits are more useful to the judges than are qualitative ones. The technology might, for example:

- Reduce toxicity (acute or chronic) or the potential for illness or injury to humans, animals, or plants
- Reduce flammability or explosion potential
- Reduce the use or generation of hazardous substances, the transport of hazardous substances, or their releases to air, water, or land
- Improve the use of natural resources, for example, by substituting a renewable feedstock for a petrochemical feedstock
- Save water or energy
- Reduce the generation of waste, even if the waste is not hazardous

3. Applicability and Impact

The nominated chemistry technology should have a significant impact. The technology may be broadly applicable to many chemical processes or industries; alternatively, it may have a large impact on a narrow area of chemistry. Commercial implementation can help demonstrate the applicability and impact of a technology. Nominations for pre-commercial technologies should discuss the economic feasibility of the technology.

The nominated technology should offer three advantages:

- A practical, cost-effective approach to green chemistry
- A remedy to a real environmental or human health problem
- One or more technical innovations that are readily transferrable to other processes, facilities, or industry sectors

The following section details the format, submission, and evaluation of award nominations. Please consider the following information carefully.

Awards Process

1. How to Enter

A. Basic Information

- **Award nominations are due to EPA by December 31, 2019. Awards will be presented in the summer of 2020.**
- Self-nominations are the most common; nominations of others are also welcomed.
- There is no entry fee.
- There is no standard entry form, but nominations must meet certain requirements or EPA may reject them.
- You may nominate more than one technology, but you must submit a separate, stand-alone nomination for each one. Multiple applications of the same general technology are most likely to win an award if you combine them in a single nomination.

B. Overall Format

Nominations must have:

- No more than eight pages, including the cover page
- Single-spaced, 12-point type, but references, captions, and footnotes may be as small as 10-point type
- Margins of at least 1 inch when printed on 8½-by-11-inch paper

Nominations may include:

- Chemical reactions, tables, graphs, charts, photographs, diagrams, and other illustrations within their eight pages.
- Text or illustrations in color, but the judges may read the nominations printed in black and white; therefore, nominations should not require color for interpretation.
- Links to published articles, patents, etc. Nominations should not rely on information in links to present their technology because judges may not follow any links.

C. Structure of Nominations

The first page must be a cover page with the:

- **Technology title** and **date** of the nomination
- **Primary sponsor(s)**: the individual or organizational owner(s) of the technology. For academic nominations, the primary sponsor is usually the principal investigator. For nominations with more than one sponsor, each co-sponsor should have had a significant role in the research, development, or implementation of the technology
- **Contact person** with full mailing address, email address, and telephone number: the one individual with whom EPA will communicate regarding the nomination. For academic nominations, the contact person is usually the principal investigator. For other nominations, the contact should be a project manager or other technical representative. We add the person listed as the contact to the list of subscribers for our electronic newsletter. Periodically, we email reminders and updates about the program to those on our list. You may opt out at any time.
- **Contributors** (optional): those individuals or organizations that provided financial or technical support to develop or implement the technology

The second page should contain the following information:

- **Technology title**
- A sentence indicating whether the nominated technology is eligible for the **small business** award, the **academic** award, both, or neither.
- The name (or number) of the EPA award **focus area** (or areas) that fits your technology. The focus areas are (1) greener synthetic pathways; (2) greener reaction conditions; and (3) the design of greener chemicals. No explanation is needed.
- One- or two-line description of the **most recent milestone** for the nominated technology and **the year it occurred**. Only one milestone and year are required; the milestone must be within the last five years.
- One or two sentences describing the **U.S. component** of the technology: the research, development, implementation, or other activities of the technology that occurred within the United States.

- An **abstract** (not to exceed 300 words) that describes the nominated technology, the problem it addresses, and its benefits. Include the degree of implementation (or commercialization) of the technology and any quantitative benefits such as the amount (or potential amount) of hazardous substances eliminated, energy saved, carbon dioxide emissions eliminated, water saved, etc. EPA plans to publish these abstracts in its annual Summary of Award Entries and Recipients. If you are nominating a technology you submitted in a previous year, you may use the abstract previously published by EPA in whole or in part. Links to previous annual summaries of award entries and recipients are available on the award winner page of our website: <https://www.epa.gov/greenchemistry/>.

The information in this section should fit on page 2, but you may continue on page 3 if necessary.

The **remaining pages** should show how your technology meets both the:

- **Scope of the program** and
- Three **selection criteria**

The judges will look for detailed explanations of:

- The **problem** (environmental or human health risk) that your technology addresses, its importance, and how your technology solves it.
- The **chemistry** of your new technology, emphasizing its novelty and scientific merit. To be eligible for an award, your technology must include a significant chemistry component. Include as much nonproprietary detail as possible, such as the specifics of your chemistry and detailed reaction pathways. Consider using chemical structure diagrams to describe your chemistry. You may include patent numbers or references to peer-reviewed publications, but add only the most important, recent ones because references take space away from other details of your technology.
- **Realized or potential benefits and drawbacks.** These may occur across all stages of your technology's lifecycle: from feedstocks to manufacture, use, and the ultimate disposal of the product. Include the human health, environmental, and economic benefits of your technology such as toxicity data and quantities of hazardous substances reduced or eliminated. If you have not done a full lifecycle analysis, discuss the impacts of your technology across the lifecycle to the extent you know them.
- **How your technology compares** with any other technologies that address the same problem. Comparing the cost, performance, and environmental profile of your technology with any competing technologies may demonstrate the broad applicability of your technology.
- **Current and planned commercialization.** For example, is your technology currently on the market? Are you building a pilot or manufacturing plant? If your technology is or is about to be commercially available, also discuss the regulatory status of any novel chemical substance or organism under any applicable laws such as TSCA¹, FIFRA², CAA³, or FFDCA⁴. EPA must assure that winning technologies comply with these laws.

D. Submitting Your Nomination to EPA

Submit an electronic copy of your nomination in a format so that EPA can select and copy text. Include the primary sponsor's name in the file name. You may want to submit your nomination as a .pdf file to minimize possible reading errors, but EPA accepts and can read all common file types. Send the electronic copy by email to greenchemistry@epa.gov. If you encounter problems submitting your nomination electronically, please contact us at greenchemistry@epa.gov or (202) 564-8849.

2. Receipt of Nominations

- EPA will consider all entries as public information.
- EPA will not return any material.
- EPA is not responsible for lost or damaged entries.
- EPA acknowledges receipt of nominations by email to the Contact Person identified in the nomination. If EPA does not acknowledge your nomination within two weeks after you submit, please contact us at greenchemistry@epa.gov or (202) 564-8849.

3. Judging Entries

A panel of technical experts convened by the American Chemical Society Green Chemistry Institute[®] will judge nominations. These anonymous experts might include members of the scientific, industrial, governmental, educational, and environmental communities. EPA may ask the designated contact person to verify any chemistry described or claims made in nominations on behalf of the judges. The judges will select as award recipients those green chemistry technologies that best meet the selection criteria. The judges may use their discretion, however, to make more than one award (or no award) in any one category.

4. Notification of Winners

EPA will notify winners prior to the official public announcement, which will be made in the summer. EPA will present a commemorative crystal sculpture to the primary sponsor(s) of the winning green chemistry technology in each of the five award categories and certificates to individuals identified by the primary sponsor(s) who contributed to the research, development, or implementation of the technology.

Contact Us

If you have questions about the scope of the program, nomination procedures, or the Green Chemistry Challenge Program, please email EPA at greenchemistry@epa.gov or call (202) 564-8849.

Please use the format below for the cover page of your nomination.⁵

Nominations with an Academic Sponsor

Title of Nomination Date of Nomination
Primary Sponsor(s): Full Name (Primary Investigator) Name of Institution
Contact Person: Full name Title Address Phone
Email
Contributor(s): (optional) Individuals and/or organizations

Nominations with a Business Sponsor

Title of Nomination Date of Nomination
Primary Sponsor(s): Company Name
Contact Person: Full name Title Address Phone
Email
Contributor(s): (optional) Individuals and/or organizations

Award Nomination Checklist

Include the following components (see “How to Enter,” page 6, for details):

- Cover page
- One sentence indicating whether the nomination is eligible for the academic category, the small business category, both, or neither
- Name or number of the EPA award focus area(s) for the nominated technology
- One- or two-line description of the most recent milestone and the year it occurred
- One or two sentences describing the activities that took place within the United States
- Abstract (300 words or fewer)
- Detailed description of how the nominated technology meets the scope of the program and the selection criteria

¹ TSCA is the Toxic Substances Control Act.

² FIFRA is the Federal Insecticide, Fungicide, and Rodenticide Act.

³ CAA is the Clean Air Act.

⁴ FFDCa is the Federal Food, Drug, and Cosmetic Act.

⁵ Individual nominations without an academic or business sponsor should use the Business Sponsor format above but enter their own name in place of the Company Name.



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