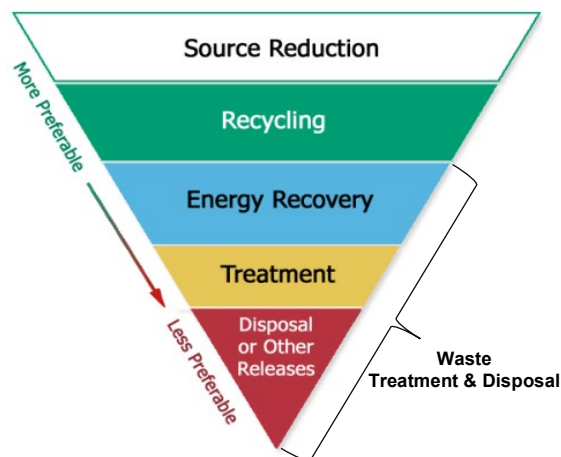


As a generator of hazardous waste through academic, research, and facilities operations, Rowan University must utilize effective waste minimization strategies. By minimizing the amount of hazardous waste that is generated, we can help protect the environment and reduce our operating costs. Waste minimization involves both source reduction and the implementation of environmentally sound recycling methods. Waste minimization does not involve the treatment of waste. Rowan University relies on a chemical waste management contractor to treat and dispose of our waste following Federal and State regulations. The most efficient solution is to conduct operations in a manner which reduces our overall production of waste.

Source Reduction

Source reduction is the most effective way to minimize the amount of hazardous waste generated. Also known as pollution prevention, it aims to reduce or eliminate waste at the source. Examples include modification of existing processes to use less chemicals, substituting hazardous chemicals with safer alternatives, and revising operating procedures to ensure optimal efficiency. Retiring old equipment containing hazardous materials (such as mercury, lead, or PCB's) and replacing them with greener, more modern equipment can also help reduce hazardous waste.



Each research and academic laboratory is required to evaluate new and existing operations to try and identify ways to minimize the quantities of hazardous waste generated. Some suggested reduction measures include:

- Keep Hazardous Waste separate from Non-Hazardous Waste; adding even small quantities of hazardous waste to a non-hazardous waste can make the entire quantity hazardous.
- Ensure that procedures are optimized so that the least amount of chemicals are required. Consider conducting micro-scale experiments whenever possible.
- Consider using simulations and other technology to demonstrate chemistry principles rather than conducting live chemical demonstrations.
- Evaluate whether a hazardous chemical can be substituted for a less hazardous or even a non-hazardous chemical alternative.
- Purchase the smallest quantities of chemicals needed for your research. Do not purchase chemicals until you are ready to begin using them. A significant source of waste is the result of expired or surplus unused laboratory chemicals.
- Do not use equipment containing mercury, unless no other viable alternative exists.
- Date all chemical containers upon arrival. Use the oldest materials first before opening a new container.
- Maintain a current chemical inventory to ensure that chemicals are used and to prevent excess ordering.
- Ensure that proper labels are maintained on chemical bottles at all times.

Laboratories who implement a successful source reduction program will see benefits in the form of lower operating costs. The university will ultimately spend less money on waste treatment and disposal fees.

Recycling

Recycling of unused chemicals and by-products is an alternative waste minimization strategy when source reduction is not feasible. Certain wastes can be used as-is or can be reprocessed and used again for additional laboratory work. Evaluate waste streams from laboratory activities to see if they may be of value before determining that they are a waste. Some potential waste recycling options can include:

- Collect cleaning solvents such as acetone and ethanol and reuse them until they are truly spent.
- Work with other laboratories within your department or elsewhere on campus to see if they have a use for a chemical you no longer need before offering it for disposal.
- Try to purchase or rent lecture bottles from vendors who will take back unused portions of gases for recovery and/or recycle the cylinders.
- Recover or reclaim precious metals and other valuable materials and arrange to have them recycled.

Additional Waste Management Strategies

While there are many ways to minimize waste generated in academic and research labs, some quantities will inevitably be generated. Because of this, it is important to manage laboratory waste in order to make treatment and disposal more cost effective. All Hazardous Waste and certain types of Non-Hazardous Waste from laboratories is taken by a specialty chemical waste management company. This company takes the waste to permitted facilities where it is treated and disposed of following all applicable Federal Regulations. There are several things that can be done within the laboratory that will help keep disposal costs down and allow for the most environmentally friendly disposal options.

- Avoid mixing water and other non-flammable chemicals in with flammable solvent wastes. Solvent wastes are often repurposed as industrial fuel. Mixing in chemicals that lower BTU values can make your waste ineligible for this cost effective and beneficial disposal method.
- Do not mix Hazardous Waste with Non-Hazardous Waste.
- Do not mix incompatible wastes together in the same waste container.
- Do not allow chemicals that require stabilizers or inhibitors to expire. Many of these chemicals can become dangerously unstable and explosive over time. If you find an expired reactive chemical, do not handle it! Contact Laboratory Safety immediately at 856.256.5105 for assistance.
- Ensure that waste containers are sealed at all times unless you are adding waste or if venting is necessary for safety. Do not leave waste containers open to the atmosphere in a laboratory or chemical fume hood. Doing so is unsafe, and is also illegal under Federal Law.
- If your laboratory needs a small quantity of a chemical for a one time operation, check with other laboratories on campus to see if they are willing to lend some from their existing inventory.

Adopt Green Chemistry Techniques

Where practical, try to incorporate green chemistry principles into your research activities. Green chemistry as defined by the [U.S. Environmental Protection Agency](#), is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal.

There are 12 core green chemistry principles:



- 1. Prevent waste:** Design chemical syntheses to prevent waste.
- 2. Maximize atom economy:** Design syntheses so that the final product contains the maximum proportion of the starting materials. Waste few or no atoms.
- 3. Design less hazardous chemical syntheses:** Design syntheses to use and generate substances with little or no toxicity to either humans or the environment.
- 4. Design safer chemicals and products:** Design chemical products that are fully effective yet have little or no toxicity.
- 5. Use safer solvents and reaction conditions:** Avoid using solvents, separation agents, or other auxiliary chemicals. If you must use these chemicals, use safer alternatives.
- 6. Increase energy efficiency:** Run chemical reactions at room temperature and pressure whenever possible.
- 7. Use renewable feedstocks:** Use starting materials (also known as feedstocks) that are renewable rather than depletable. The source of renewable feedstocks is often agricultural products or the wastes of other processes; the source of depletable feedstocks is often fossil fuels (petroleum, natural gas, or coal) or mining operations.
- 8. Avoid chemical derivatives:** Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.
- 9. Use catalysts, not stoichiometric reagents:** Minimize waste by using catalytic reactions. Catalysts are effective in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and carry out a reaction only once.
- 10. Design chemicals and products to degrade after use:** Design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.
- 11. Analyze in real time to prevent pollution:** Include in-process, real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts.
- 12. Minimize the potential for accidents:** Design chemicals and their physical forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires, and releases to the environment.

While green chemistry principles may not be feasible in all research situations, the successful use of even one principle has the ability to significantly reduce the quantity of hazardous waste generated in your laboratory. These principles can also help the university to continue conducting meaningful teaching and research while also reducing our environmental impact. Waste minimization is an important component of Rowan University's academic and research laboratory operations. It ensures that we keep operating costs low and shows that we are dedicated to protecting the environment.

Please contact Laboratory Safety at LabSafety@Rowan.edu or 856.256.5105 with any questions related to Rowan University's Waste Minimization Program.