Laboratory Guide

Steps to improve sustainability practices in your lab

WATER TECHNOLOGIES

ELGA VEOLIA

The sustainability challenge in science

Science plays a major role in developing new and more sustainable technologies, materials, and systems. But, paradoxically, the world of science has a sustainability challenge of its own; plastic and paper waste, energy usage, and water consumption are key areas where laboratories have a disproportionately sized impact:

Plastic

Plastic waste is a notorious by-product of laboratories. Life science research labs alone are estimated to produce 1.8% of the world's total plastic waste.[1] Since that study, the COVID-19 pandemic prompted a general increase in single-use personal protective equipment and plastic packaging[2], adding to the collective carbon footprint of science.

Energy

Energy consumption in laboratories is highly intense with clinical laboratories using up to 10 times more energy than equivalent sized offices,3 and high-energy equipment like ultra-low temperature freezers, use as much energy per year as an entire household.4

Water

Water accounts for less than 1% of all water on the planet5 and the world faces a global shortfall of 40% by 2030,6 yet laboratories use as much as five times more water than an equivalent sized office.7

Our guide aims to help you develop more sustainable laboratory practices — without compromising on the quality of your results. We will highlight strategies such as:

- Making sustainability part of your culture
- Investing in energy saving equipment
- Adopting automation and digitalization strategies
- Reducing waste
- Switching to glass
- Getting smart about water use

Organizational change: What everybody can do

Although waste can be reduced in many areas, sustainability itself is difficult to measure and should be considered an ongoing process of implementing good practices. The successful implementation of these practices requires cultivating a culture of sustainable thinking within the organization. As long-lasting organizational change tends to come from the top, it's up to leadership and management to encourage the right mindset among lab workers and staff.

To coordinate the transition to a more sustainable lab, consider appointing a Sustainability Officer to encourage the implementation of sustainable practices and gather feedback from the lab team. By providing clear feedback, lab workers can shape sustainable practices without impacting scientific quality.

Consider investing in energy saving equipment

Laboratory equipment is often operating 24/7, resulting in high energy usage compared to a home or office block.[3,4] Thankfully, though, manufacturers are more conscious than ever of their products' ecological impact and are now designing new models with these challenges in mind. As such, it can be a good idea to consider upgrading to more sustainable and eco-friendly equipment. Additionally saving carbon typically results in reduced energy costs.

Questions to consider before investing in new lab equipment

Many labs may be tempted to go out and get the latest shiny new piece of kit. But before you do, there are a couple of considerations to make to ensure any new purchase fits into your wider sustainability strategy.

Is existing equipment functional and adequately serving its purpose?

If it is, disposing of it may have a higher environmental impact and create more waste. Instead, wait until the product reaches the end of its life cycle before replacing.

Does this equipment get enough use to warrant upgrading?

If equipment only gets used occasionally, consider sharing it with other groups to save on running and maintaining two devices.

What features should you look for when upgrading a device?

While the rapidly expanding pool of more sustainable tools is a promising development, it can make selecting the right device challenging, especially given that there are so many factors to consider and compare when opting for an environmentally friendly device. To make the best choice, be sure to ask vendors about:

Energy efficiency rating

Upgraded models tend to be more energy efficient than their predecessors but check labelling — the EnergyGuide label with the Energy Star logo in the US, or a C and above Energy Efficiency label in Europe — to ensure the device lives up to its energy efficiency claims.

Power-saving modes

Beyond overall energy efficiency, some devices may include a power saving or eco-friendly mode at which they operate while consuming less energy cost and reduced CO2 emissions associated with energy consumption.

Construction materials

While energy efficiency matters in running the device day-to-day, the materials used in construction also have a major impact on carbon emissions. For example, a device made from low-impact or reclaimed materials such as recycled and bio-based plastics is typically more sustainable than a device made of virgin plastic.

Sustainable packaging

Packaging materials also contribute to the carbon footprint of new devices. Look for more sustainable options such as recyclable packaging, fsc sustainably sourced packaging and, for larger pieces of equipment, wood.

Eliminate human error, reduce waste

Human error is a fact of life, which, in the laboratory setting, leads to repetition of experiments and the unnecessary waste of reagents and consumables. To minimize the risk of waste, consider replacing laborious and error-prone manual tasks with precision automation. Devices like liquid handling robots, PCR machines, chromatography platforms, and incubators can help automate intricate workflows from end-to-end, reducing human error and, thus, waste.

What's more, many of these automated devices integrate with digital tools such as laboratory information management systems, analytical software, and electronic lab notebooks (ELNs). Digital systems enable lab workers to further eliminate errors from their workflows and, in the case of ELNs, decrease their reliance on paper, helping to reduce their carbon footprint over time.

Whether automating or performing experiments by hand, following best green practices can help you minimize waste in your lab. The 12 principles of green chemistry[8] and the 10 principles of green sample preparation[9] are examples of recommend best practices for reducing chemical reagent and plastic consumable waste.

Miniaturize: Reduce waste by scaling down

One downside to adopting automation is that it may lead to more plastic waste if the laboratory significantly increases its experimental throughput as a result. Lab workers can mitigate this risk by miniaturizing their protocols using specialized liquid handling robots.

Bear in mind that not all protocols lend themselves to miniaturization. To check if your protocols can be miniaturized, speak with your liquid handling robot suppliers, and check the available literature for specific techniques (much of which can be accessed easily online).

Switching to glass

Reliance on single-use plastic has become a well-known issue in the scientific community. While plastic is cost-effective and has many uses in the lab, it is often impossible to reuse or recycle, due to the risk of contamination, leading to significant amounts of waste.

Recycled and bio-based plastic labware could, in theory, help mitigate this issue, but it's not yet readily available. Glass, on the other hand, is and serves as an effective replacement for single-use plastic. Traditionally used for non-disposable labware, glass is biologically inert, reusable, and recyclable.

But, it's important to note that despite these positives, glass has its downsides and may not be the right option for your lab or workflows.

· Glass is more expensive than plastic

· Glassware must be washed, rinsed, and sterilized after use

· Glass is often not compatible with automation devices

· Some specialized labware is not readily available in glass

Get smart about water use

Water makes up a tiny fraction of all water on the planet, most of which is locked away in glaciers,[6] so it is essential that it is conserved and used efficiently. Since laboratories have such high water needs, researchers need to think about implementing a water conservation strategy.

Ways to reduce water waste in your lab

Water conservation strategies in the laboratory setting are surprisingly simple, requiring little effort to implement. By adopting these easy practices, substantial reductions in water waste can be achieved.

Run water-intense devices more efficiently

Using dishwashers and autoclaves only when they are full maximizes efficiency, lowers operating costs, and saves on both water and electricity use.

Check for leaks and drips

Leaks contribute to unnecessary water consumption and utility costs. A leak of just one drip per second can waste 13,638 litres per year[10] so it's important to regularly check for leaks in the lab and report issues promptly to building maintenance to avoid damage to ensure efficient water usage and avoid damage to equipment.

Use efficient water purification systems

Pure and ultrapure water are essential in many laboratory workflows, but water purification systems can sometimes be inefficient and generate large quantities of wastewater in the process. When systems reach the end of their operational life ensure that new units are equipped with the most efficient RO systems that reduce waste water.

A more sustainable and resilient future for science

Sustainable laboratory strategies cannot be implemented overnight — it takes an organization willing to develop a culture of sustainable thinking and consider the challenges and merits of adopting sustainable strategies like those highlighted in this guide.

Implementing sustainable practices such as making sustainability part of the culture, investing in energy-saving equipment, adopting automation and digitalization strategies, reducing waste, switching to glass, and getting smart about water use can significantly reduce a laboratory's carbon footprint and contribute to a more cost effective and sustainable future for scientific research and the planet at large. Working together, and with their suppliers, laboratories can implement practices that will help bring about a more sustainable and resilient future for science.

To learn more about how to improve the sustainability of your laboratory while maintaining the highest quality in water purification check out our next generation of water purification systems — built with sustainability in mind[B1] .

References:

[1] https://www.exeter.ac.uk/about/sustainability/sustainablelabs/labplastics/

[2] https://www.eea.europa.eu/publications/impacts-of-covid-19-on

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[5] https://www.nationalgeographic.com/environment/article/freshwater-crisis

[6] https://turningthetide.watercommission.org/

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[9] https://www.sciencedirect.com/science/article/pii/S0165993622000139

[10] https://ori.hhs.gov/education/products/wsu/data_lab.html

[B1]Link to blog.

[B2]References will be fully formatted once draft feedback has been made.

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