

Cold Storage Management Strategies

Some of the most important pieces of equipment at the NIH are cold storage units such as refrigerators, lab grade freezers (-20 °C to -40 °C), ULT freezers (-80 °C) and cryogenic freezers (-150 °C). This equipment is crucial for storing and preserving millions of samples, reagents, cultures and other research items across the NIH. Cold storage is also important because of the energy-intensive nature of maintaining cold temperatures around the clock. A non-Energy Star ULT freezer consumes approximately 20 kWh of electricity per day, the same amount as the average U.S. household.¹ Another important aspect of cold storage use is the space required to house each unit. Space is a limited commodity and excess cold storage units can limit the availability of space for other research activities. In a worst-case scenario, cold storage units may be placed in areas with poor air flow, like a hallway. The freezer operation and restricted air flow increases the ambient temperature, causing the compressor to work harder and longer, consuming more electricity and increasing the risk of a freezer failure. There have been experiences of ULT freezers raising a hallway temperature to 90 °F, resulting in an estimated 24% increase in energy consumption.² [Climate change](#) will further compound this issue by requiring greater air conditioning use to maintain a suitable indoor ambient temperature for cold storage units. A careful balance must be maintained between the need for cold storage units and the energy and space these units require.

There are many strategies that can minimize the amount of required cold storage. A few of these are listed below, although more information is available on the [NIH Freezer Challenge website](#) and in the [NIH Freezer Challenge Guide](#). Please consider adopting one or more of these strategies:

- **Share cold storage space with other labs.** Sharing cold storage resources is one of the easiest ways to save space while fulfilling the need for sample storage. A useful starting point may be inquiring with other labs in your IC that are within close proximity to see if they have extra cold storage or to offer to share your own refrigerators or freezers. It may also be beneficial to share emergency freezers, since these freezers tend to be used sparingly. Lab inspections from the NIH estimate 10% of freezers are used in a backup capacity. This figure could be greatly reduced through cold storage sharing.
- **Consolidate your cold storage units.** Research into the efficiency of ULT freezers suggests that smaller freezers are less efficient than larger freezers.² The smaller freezers have a larger surface area to volume ratio, which is less efficient to cool, and they have smaller, less efficient compressors. If provided the option to consolidate your cold storage, it is recommended to purchase freezers over 20 ft³.² This could also provide more opportunities to share cold storage with other labs.
- **Discard old samples.** Throwing out old samples is a great way to create more cold storage without purchasing any new units. As projects change or samples expire, many labs will have thousands of samples that can be discarded. A sample inventory can greatly assist with this process, making it easy to identify and locate old samples.

- **Store samples in less energy-intensive cold storage.** The most energy-intensive type of cold storage is the ULT freezer, which is also prized as a very safe method for storing samples. However, it may be the case that samples are stored in a ULT freezer when they could otherwise be stored safely in a lab-grade freezer or refrigerator. Storing samples in the least energy-intensive type of cold storage will help ensure space in ULT freezers is available without purchasing more units. As an example, bacterial cultures have been found to remain viable in a lab-grade freezer (-20 °C to -40 °C) for 1-3 years.³ In this case, a short-term project might make it more realistic to store the bacteria cultures in a lab-grade freezer, rather than a ULT freezer.
- **Utilize high-density sample storage options.** Organization is a crucial aspect to efficiently utilizing cold storage space, both for increasing the capacity to store samples and for finding samples quickly. High-density storage boxes are available from numerous companies and are estimated to increase sample storage capacity by as much as 116%.⁴ Utilizing a high-density storage option can greatly increase the storage capacity of existing freezers and refrigerators.