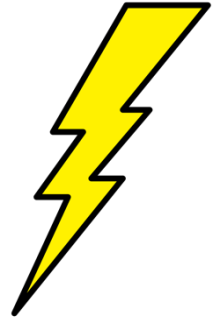


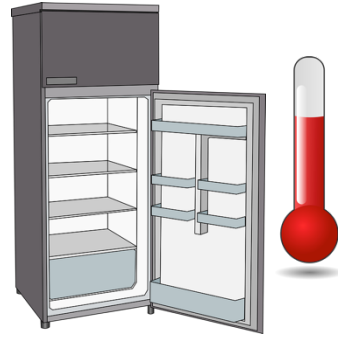
Freezers are major energy users in the lab



- 1 average -80°C freezer uses **12,000 kwh** of energy per year
 - The same amount used by 1 family home in the US per year!
- General tips for reducing freezer energy consumption:
 - Maintain a detailed log of freezer contents on the outside of the door, and open the door as briefly as possible (each 1 minute the door is open → +10 minutes to recover temperature)
 - Keep freezers full – fill empty spots with ice packs or empty boxes
 - Regular freezer maintenance – clean dust off filter, defrost ice buildup
 - Clean out unneeded materials regularly and combine contents of multiple freezers
 - Consider replacing old inefficient freezers (each year → +3% more energy consumed)

“Chill up” from -80°C to -70°C !

- 15 years ago, all samples were stored at -65°C or -70°C
- The standard only became -80°C due to effective marketing with new ULT technology, not demonstrated scientific need!
- **Higher temperature = longer freezer lifespan & lower energy consumption**
- **“Chilling up” uses 30-40% less energy with no harm to samples**
- Researcher concerns:
 - Why change if samples are safe at -80°C ?
 - Will samples be safe at -70°C ?
 - Won't samples be safer longer at lower temperatures if freezer fails?



Growing research shows samples are safe at -70°C

- UC-Boulder has “chilled up” 60% of lab freezers
- Online collaborative database of samples successfully stored at -70°C:

<https://docs.google.com/spreadsheets/d/13UvBeoXAhwSHshSYoUDHwcxWiW7qYLnUb-eLwxJbCYs/edit#gid=0>

Table 1: Summary of samples stored in ULTs with -70°C set points

Sample Type	# of Labs	Avg. Storage time (years)	Range storage time (years)
Animal tissue (including human)	31	6	1 to >10
Bacterial stocks	29	7	2 to >10
RNA	25	5	0.5 to >10
DNA (including cDNA)	24	6	2 to >10
Purified proteins	24	5	1 to >10
Competent cells	20	3	0.5 to 6
Cell extracts	17	5	1 to >10
Enzymes	13	5	1 to 10
Cell lines	12	6	1.5 to >10
Yeast stocks	11	7	10 to >10
Antibodies	7	7	3 to 10
Plant tissue	7	3	0.5 to 5
Virus stocks	5	6	3 to >10

* Based on a database of self-reported information provided by researchers at UC Davis, CU Boulder, UC San Diego and UC Riverside [3].

RESEARCH

Open Access

Long term stability of paraoxonase-1 and high-density lipoprotein in human serum

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JOURNAL OF CLINICAL MICROBIOLOGY, Mar. 2004, p. 1257-1259
0095-1137/04/\$08.00+0 DOI: 10.1128/JCM.42.3.1257-1259.2004
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Vol. 42, No. 3

Long-Term Preservation of Fungal Isolates in Commercially Prepared Cryogenic Microbank Vials

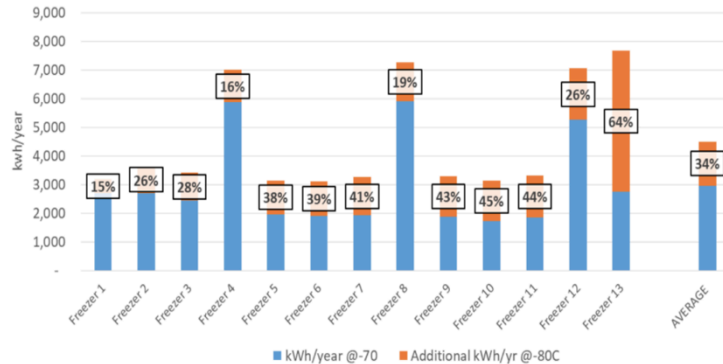
A. Espinel-Ingroff,^{1*} D. Montero,² and E. Martin-Mazuelos²

The abstract features the SeraCare Life Sciences logo on the left and the MESSENGER logo on the right. The title is centered in white text on a dark background. Below the title, the authors' names and affiliations are listed in smaller white text.

greenlabs.ubc.ca/events/chillup/
greenlab.mit.edu/cold-storage
colorado.edu/ecenter/greenlabs/lab-energy-efforts/freezers/70-0c-efforts

Saving the planet saves money

Savings from ULT "Chill Up" - Biogen, 2018



Freezer Recommendations

Go back to Recycling Freezers (link words "Recycling Freezers" w/ pub.page)

Here's what you can do:

Chill Up: Raise Temperature in Ultra low Freezers

Freezers, Ultra low				Monthly Average				Monthly
Description	Brand	Model	~Age	On at -80		Raised Temperature at -70		Potential Savings
*Isotemp -80	Basic Freezer		2002	\$49.59	684.72 kWh	951 W	n/a	n/a
**Baker	UF 755 G		2010	\$40.00	532 kWh	n/a	n/a	n/a
**Forma Scient	923		1998	\$51.00	678.24 kWh	942 VA	\$46.94	624.24 867 VA
**Harris	ELT-14LS-90-D31		2004	\$42.77	568.8 kWh	790 VA	\$31.08	413.28 574 VA
**Revco (chest)	ULT 2090-5-A31		2002	\$57.77	768.24 kWh	1067 VA	n/a	n/a
**Revco	ULT 2586-5-D39		2005	\$67.14	892.8 kWh	1240 VA	n/a	n/a
**Revco	ULT 2586-9SI-A38		2007	\$56.69	753.84 kWh	1047 VA	n/a	n/a
**Revco	ULT 1786-3-A14		1998	\$41.80	555.84 kWh	772 VA	n/a	n/a
**Revco	ULT 2586-9-A35		n/a	\$52.68	700.56 kWh	973 VA	\$43.32	576 800 VA
**Sanyo	MDF-U71VC		n/a	\$74.50	990.72 kWh	1376 VA	\$67.52	897.84 1247 VA
**Sanyo	MDF-U73VC		n/a	\$60.86	809.28 kWh	1124 VA	\$57.39	763.2 1060 VA
**Thermo (chest)	ULT1090-3-A34		n/a	\$35.41	470.88 kWh	654 VA	n/a	n/a
**Thermo Forma	916		2001	\$65.08	865.44 kWh	1202 VA	n/a	n/a
**VWR	5463			\$40.99	545.04 kWh	757 VA	n/a	n/a

*Penn metering project **Data collected from UC Davis, found at: <http://labs21.lbl.gov/wiki/equipment>

Notes:

Monthly Potential Savings comes from turning up the freezer from -80 to -70, many items are safe at this temperature and the compressor does not need to work as hard to keep the freezer at a higher temperature.

Monthly Cost based on \$0.0752/kWh

Creating initiatives to improve freezer sustainability

- Annual UC-Davis Freezer Challenge (December 2019 - May 2020)
 - Awards given to individual labs and institutions
 - Winners published in Nature
- Penn Ultra Low Temperature Freezer Program
 - Penn will pay \$500 to properly recycle an old lab freezer
 - Incentives for purchasing efficient new freezers
- **Let's create more initiatives!**
 - Plan individual lab freezer clean up days – coordinate with neighboring labs and combine!
 - Penn campus freezer challenge?

Freezer Energy Usage	Incentive Amount
500Wh/day/cu-ft or less	\$2,500
500 to 750 Wh/day/cu-ft*	\$1,500