

Application for a Large Grant from the Sustainable CU Environmental Improvement Initiative

Title: Incentivizing Responsible CU-Boulder Laboratory Freezer Usage and Energy Consumption through Participation in the First National Freezer Week Competition between Universities

Applicant:

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Description of Project:

BACKGROUND: Freezers, refrigerators, and refrigerated equipment in scientific laboratories are collectively huge consumers of energy on the CU-Boulder campus. Old and very inefficient freezers are commonly found in labs. Ultra-low temperature (ULT) freezers (also commonly known as -80°C freezers) are growing in number and are particularly large consumers, each using approximately the same electricity as an entire average US house (ULTs typically consume 20-30 kWh/day) plus the energy consumed as a result of the need to remove the large amount of heat rejected by these freezers into the laboratory space. Furthermore, while not true of all labs, lab freezers are often times poorly maintained, freezer space is poorly managed, some freezer samples are poorly labeled, freezer samples are often stored at temperatures colder than necessary (due the mentality that colder must be better), and labs generally have more than sufficient funding to simply buy another unit when their old one gets filled to capacity (rather than working to better organize, clean out, and efficiently use the space they presently have).

These problems surrounding laboratory freezers are not isolated to CU-Boulder and are, in fact, problems on University campuses nationwide. Addressing these problems is not an easy task since:

1. going through freezers is not a pleasant thing to do (I speak from experience on this one; it is cold and decisions have to be made quickly since no one wants to leave the door open too long which risks raising the temperature to high and potentially affecting other materials stored in the unit)
2. labs are intense work environments where time is precious and meant to be spent on research, not on cleaning out freezers
3. labs are NOT directly responsible for their energy bills and thus energy conservation is not a high priority

4. ULT freezers are prized possessions because of their ability to effectively preserve biological samples long term and thus, in some labs, discussions about their large carbon footprint are not welcome.
5. often times there are items in freezers whose owner has long left the lab and thus present lab members do not know what it is, if it is important, and they are afraid to throw it out in case it will be needed someday in the far distant future.

NATIONAL CONTEST (April 4-8, 2011): The need to address energy consumption by laboratory freezers has compelled the University of California at Davis (UC-Davis) to challenge campuses across the nation to participate in a freezer week contest. The main objective is to give campuses a reason, through a friendly competition, to appeal and incentivize labs to step up to the plate to address the abundance of issues needing attention surrounding freezers. The contest also gives lab members the freedom to more openly discuss these problems by raising awareness that these problems are not isolated to their lab, their department, or their campus, which can sometimes be assumed since many graduate student lab members have only ever known their particular lab environment.

The contest between campuses is based upon a point system where identified actions gain the competing university a predetermined number of points. Various actions with different levels of points exist; some actions can be considered for every freezer (and refrigerator) participating in the contest such as inventorying, discarding unneeded materials (measured by volume), and consolidation/retirement of unneeded units while other actions are more specific to the type of freezer such as raising the temperature set-point on a ULT or defrosting coils. I have been invited to give input on the point system which is nearing final draft form.

There are also multiple categories for a university to win such as the most points (normalized and unnormalized-2 categories), the most units retired (freezers and refrigerators included), the greatest percentage of ULT freezers at -70°C or warmer, the oldest sample discarded, the gnarliest freezer photo, and more. Each category will have a fun award name and notoriety is the only prize for winning a category.

In addition to CU-Boulder, other universities including Harvard, University of Pennsylvania, and University of California at Santa Barbara have accepted UC-Davis' challenge to a National Freezer Week Contest. UC-Davis is encouraging each participating university to incentivize lab participation on their campus.

INCENTIVIZING LAB PARTICIPATION ON CU-BOULDER CAMPUS: Since scientific labs generally have large budgets and any dollar incentive amounts that can be offered to labs are usually minor in comparison to those large budgets, the best way to encourage participation in a contest like this is to offer incentives directly to the graduate students, post-doctorates, technicians and undergraduate students working in the lab. These individuals are the ones who primarily use the freezers and will be doing most of the work related to the contest action items anyways.

Free food goes a long way with incentivizing lab members and CU Green Labs intends to use that incentive for this contest. Since cleaning out and inventorying freezers is a particularly tough chore to persuade lab members to do, additional incentives are really needed to gain lab member interest and make this a truly successful event on the CU-Boulder campus. Therefore, in addition to funding for pizza lunches, the largest portion of this proposal is a request for funding to purchase gift cards to local restaurants, which have proven to be very effective in raising interest in smaller contests previously conducted by the CU Green Labs Program. For a more detailed look at how gift cards will be used, see the budget section below.

CONTEST STRUCTURE ON CU-BOULDER CAMPUS: Labs interested in participating in the contest will need to register via Survey Monkey by Feb 28th, 2011 (or the very beginning of March). Registration requires a commitment on the part of the lab to 1) inventory freezers to at least box or container level (in other words, provide information on who owns the box and what sample types are in the box but not inventorying the box contents themselves), 2) adopt a system to maintain that inventory (sample inventorying systems will be prepared ahead of time as examples of what labs may want to use) and 3) set up labeling requirements for samples stored in freezer (minimum requirements will be set by CU Green Labs) and make sure samples already in the freezer meet those requirements. At the time of registration, labs will also need to indicate the number of freezer (and refrigerator) units that will participate in the contest and answer questions concerning what action items the lab plans to take part in during the contest.

Registration information will be shared with Environmental Health and Safety (EH&S) at the end of the first week of March so they have time to adequately prepare for the contest. Also per EH&S' request, each lab participating in the contest will be assigned one contest day to clean-out their freezer (and refrigerator) units. EH&S and CU Green Labs will determine this schedule together. Labs will be grouped by location for their assigned clean-out day and, if the budget below is approved, a free pizza lunch will be provided to the labs on their particular clean-out day. Outside of cleaning-out old materials from freezers, labs may participate in any other action items on any other day of the contest.

CU Green Labs and EH&S will be available throughout the contest to answer questions, address issues and help where needed. Each lab will submit their final results to CU Green Labs via Survey Monkey. Results will also be submitted to the National Contest via Survey Monkey. CU Green Labs will also be checking in to ensure labs are accurate in their submissions for incentive awards. During the contest "checks for accuracy" will focus on the materials being thrown out, but after the contest "checks" will focus on the inventorying and labeling systems the labs have chose to implement in their labs. Each lab will receive their gift cards only after CU Green Labs has verified that all claimed incentive action items have been completed and implemented by the lab.

In addition to verifying incentivized actions, a number of action items will require follow-up by CU Green Labs after the contest week has ended such as 1) setting up the maintenance program in those labs that signed up, 2) disposing units which were submitted for retirement or replacement, 3) checking in to see if inventories and labeling systems are being used and maintained as promised (possibly via a follow-up inventory contest), and 4) a luncheon hosted by Qiagen 4-5 weeks later for those 20 labs who tried room temperature sample storage and tested the samples for compatibility with their experiments.

Budget: Request for \$28,500 from Sustainable CU to incentivize the freezer contest through gift cards, pizza, and funding for inventorying software

IMPORTANT INFORMATION: The proposed budget items below are estimates and best guesses on participation in the contest if 100 labs were to participate. However, it could be that only 25-50 labs participate or that more than 100 want to participate and I need to limit the contest to 100 based upon the proposed budget below. It is difficult to determine how many labs will participate and in what way they will participate. Therefore, if less funding is needed in one category below but more funding is needed in another category, I plan to move funds from one category to another. Overall, though, if less funding is ultimately needed than the total \$28,500 proposed here, then CU Green Labs would only use the funding that is actually needed. If the incentive requests exceed the total budget proposed here, then incentives will be dispersed to labs in the order in which labs registered for the contest until funds run out (this fact will be advertised to labs to get them to sign up as soon as possible).

It is my hope that you will read the information I have placed in Appendix A which describes what I experienced working in a lab at CU-Boulder with freezer units. I think it will give you a good sense of why this project needs to be funded at the proposed level. This is a large issue on campus that should to be addressed. In my opinion, however, the contest will only make a real dent in the problem with sufficient funding to really incentivize labs to participate.

GIFT CARD INCENTIVES: Totaling \$21,790

\$4125 for incentivizing removal of unneeded materials from freezers (and refrigerators)- this EXCLUDES water jugs, containers, etc. being used to fill excess volume in the freezers for energy efficiency and freezer performance purposes. The volume of unneeded material removed will be measured by compactly filling (or partially filling) a plastic tub and estimating the volume based upon the tub's dimensions.

- \$25/ft³ removed from ULT freezer (also frequently know as -80°C freezer)
- \$5/ft³ removed from all other freezers and refrigerators

Justification: It is not uncommon to find materials in a laboratory freezer that have long been forgotten and no one knows what it is or who it belongs to; materials that could have remained there for years or even a decade for no reason at all. It is difficult to estimate how much freezer space at CU-Boulder is occupied by materials that really do not need to be there. However, EH&S and I feel it could be as high as 20-25% and lab managers at UC-Davis and elsewhere estimate that 10-30% of lab freezer contents are expired, obsolete, or have lost records, and thus have no value. [Please read Appendix A on how such things can happen based upon my experience working in labs.] Because inefficient use of current freezer space on campus can lead to the purchase of additional freezer (and refrigerator) units unnecessarily and therefore unnecessary energy consumption, there is a real need to address this problem. ULT and -20°C laboratory freezers also often hold infectious and bio-hazardous

materials. As a result, EH&S would also like to see freezer clean-outs and proper disposal of materials that are no longer of research value for the benefit of a safer lab environment.

A typical 20 ft³ ULT freezer uses about 20 kWh/day which equates to 1 kWh/ft³/day or 365 kWh/ft³/year costing \$23.73/ft³/yr at \$0.065/kWh. In contrast, a typical -20°C freezer uses \$2.30-\$5.50/ft³/yr depending on the age and energy rating of the unit. Taking these numbers into consideration and the incentive levels I feel are needed to effectively move labs to remove unneeded materials from freezers (and refrigerators), I have come up with the incentives amounts described above. If we assume we get 100 labs signed up for the contest and on average each lab removes 1.25 ft³ of materials from ULT freezers and 2 ft³ from all other units, that would come to a total of \$4125 in incentives.

\$8000 for incentivizing inventorying and proper labeling of materials in lab freezers (and refrigerators)- participating labs in the contest are required to do this to at least the box/container level

- \$40/ULT freezer inventoried to box level and meeting labeling requirements determined by lab (but meeting minimum labeling requirements set by CU Green Labs)
- \$7/unit for all other full size freezers (must be 10 ft³ or more in size)
- \$4/unit for each refrigerator (must be 10 ft³ or more in size)
- \$40 additional/ULT freezer inventoried to sample level with software
- \$40/lab for those labs who already have their freezers inventoried (to either box or sample level) who are willing to act as references/mentors to other labs just setting up their systems.

Justification: Inventoried freezers, labeling requirements for freezer samples, and a system (agreed upon by the lab members) in place to maintain the freezer inventory are key to working towards eliminating the problems described in the first budget item and in Appendix A. They also are key to properly identifying any biohazardous materials that might otherwise be handled or used inappropriately by lab personnel. However, inventorying a ULT freezer can be a tedious, cold and thankless task which is why these incentives are being offered. For those labs that already have an effective system in place, they can also receive an incentive to award them for their excellent example if they are willing to be a mentor/reference to other labs that could learn from the process they have in place.

A typical ULT freezer uses 7300 kWh/yr or \$475/yr in energy costs at \$0.065/kWh. A typical -20°C freezer uses \$40-100/yr in energy cost/yr. I have chosen incentive values which are approximately a tenth of this consumption cost but which I also believe are in line with what is necessary for labs to really take interest in this aspect of the contest. If we assume 100 labs participate in the contest and on average each lab has one ULT freezer, four -20°C freezers, and two refrigerators which they inventory to box level and 10 labs also inventory their 1 ULT freezer to the sample level, the total comes to \$8000 (please note that it is my experience that the majority of labs do not have their freezers inventoried).

\$1030 for incentives for raising the temperature set-points of freezers by 10°C - as part of this incentive, the lab must also provide information on the types of samples being stored in the freezer long-term (6 months or more).

- \$30/ULT freezer (must be raised to -70°C or warmer)
- \$25/ -40°C or -30°C freezer
- \$10/lab for those labs who already have their ULT units at -70°C or warmer and have no plans of lowering the temperature of their units

Justification: According to measurements made by the University of California at Davis, raising the temperature on ULT freezers from -80°C to -70°C saves 2kWh/day on average (http://labs21.lbl.gov/wiki/equipment/index.php/Category:Ultra_Low) which equates to a 730kWh/yr/freezer saved or \$47.45/yr/freezer in energy savings (at \$0.065/kWh). -40°C and -30°C freezers are also large consumers (although their presence on campus is less prevalent than ULT freezers or -20°C residential style freezers); a -30°C freezer unit set at -25°C consumed 2222 kWh/yr/freezer or \$144/yr/freezer at \$0.065/kWh and a unit at -40°C or -30°C is expected to consume more. If we assume that raising a -40°C or -30°C unit by 10°C will save 0.75 kWh/day, that is equivalent to \$17.80/yr/freezer.

Taking these numbers in consideration and the fact that a jump in temperature from -80°C to -70°C is an easier switch for a lab (since both are far from water's freezing point of 0°C) than a switch from -40°C to -30°C or -30°C to -20°C, I have set the incentive values above. Plus, to thank those labs who switched their ULT freezer temperatures earlier and encourage them to keep their units at -70°C or warmer, I have also included a small incentive for them. If we assume that 30 ULT freezers are raised by 10°C, two -40/-30°C freezers are raised by 10°C, and there are 8 labs that are already at -70°C that comes to a total of \$1030.

\$1250 for incentives for providing information on long term storage (≥ 6 months of biological samples stored at temps of -70°C or warmer)

- \$10/temp for each lab that has not previously provided this information. Information could be provided at temperatures such as -70°C , -60°C , -40°C , -30°C , -20°C , 4°C , etc. and will be collected by Survey Monkey. Already I have collected some data on this topic through previous efforts of CU Green Labs which I will be sharing with labs participating in the contest at CU-Boulder and nationwide.

Justification: Often times, little science goes into determining what temperature biological samples are stored at. If it is unknown what temperature a sample should be stored at, the mentality used is that colder must be better. This is the same mentality (plus great advertising on the part of manufacturers) that has led researchers to purchase ULT freezers capable of -80°C or lower (rather than -60°C or -40°C units for example) and to set their ULT freezers to -80°C rather than -70°C or -60°C (temperatures which are likely to be just as effective at preserving biological samples long term and also lead to better freezer performance by reducing the workload on the freezer compressor). Interestingly, there are researchers on the CU-Boulder campus that can remember times when -70°C ULT freezers were available, but not -80°C ULT freezers. They report that their samples are no better preserved at -80°C than they are at -70°C , yet nearly all ULT freezers at the CU-Boulder campus are capable of -80°C or lower and the majority are set at -80°C or colder.

There is also the issue that many samples presently stored at ULT temperatures could also be preserved just as effectively at -20°C which, of course, is storage requiring a fraction of the energy that ULT temperature storage requires.

One of the most effective ways to get labs to increase the temperature on their ULT freezer to -70°C or to prevent the future purchase of ULT freezers unnecessarily (rather than a -40°C or -20°C freezer) is to provide information on warmer freezer temperatures being used successfully in other labs for long term storage (6 months or greater) of particular samples types. This is the purpose of this aspect of the contest; to collect that data to share with other labs (at CU-Boulder and nationwide) in future conservation efforts with freezers. If we assume that 100 labs submit data on 1.25 temperatures on average, that comes to a total of \$1250.

\$700 for 20 labs to try out room temp storage of DNA or RNA (participation requires that lab tests samples 3-5 weeks later)

- \$35 for the first 20 labs that sign up (free products and a free follow-up luncheon for 2 members/lab will be provided by Qiagen)

Justification: There is a new technology available that allows the short and long term storage of DNA, RNA, and materials saved for later extraction of DNA and RNA at room temperature. Presently DNA and RNA are typically stored at ULT freezer temperatures for long term storage and thus the ability to store these materials at room temperature is shock to lab members resulting in reluctance to try the new storage product and the need for an incentive as part of the freezer week contest. Interestingly, a switch to room temperature storage will not only result in obvious energy savings but also better security for the researcher's samples since it will avoid the dependence on continuous electricity or a freezer, both of which will fail at one point or another.

Qiagen who sells the DNA room temperature storage product has offered 100-150 free tubes for lab members to test out and the willingness to pay for a follow-up luncheon (not to exceed \$250) 4-5 weeks later. Biomatrix has also offered free RNA, bacterial clone, etc. room temperature storage products for the labs to test out free of charge.

\$2950 for improving the maintenance conditions of freezers (and refrigerators) in CU-Boulder's labs

- \$10/lab for each new lab that signs up for the CU Green Labs Maintenance Program and provides the name of a lab member as a point of contact for this project
- \$8/unit ($\geq 10\text{ ft}^3$ in size) and \$4/unit ($< 10\text{ ft}^3$) for defrosting each manual defrost freezer (or cold incubators) with more than 0.25 inches of ice or frost built-up anywhere in the unit
 - For ULT freezers, the snow-like material inside must be removed and the ice gently removed from the seal so it seals well when closed (also for chest ULT freezers, use of a jug with water in it as a weight to keep the lid closed and well sealed is required).
 - All other freezers (and cold incubators) must be emptied and completely defrosted
- \$5/unit for cleaning the coils (and filters) on units where needed due to build up of dust

Justification: Some labs do a great job of maintaining their freezers and refrigerators, but most do not. A walk through a lab building on campus where freezers are prevalent would result in findings (in some cases) of ULT freezer filters blanketed with dust, refrigerator & freezer coils coated with dust, and in the worst cases, ULT chest freezers with lids which cannot close due to too much frost or manual defrost -20°C freezers with so much frost/ice in them that very little can fit inside. Most of the

problem stems from the fact that many labs are simply not sure what they need to be doing to maintain their units. The impact is that these units are all consuming more energy than they need to because they are being poorly maintained.

The CU Green Labs refrigerator/freezer maintenance program which was initiated in the summer of 2010 will visit a lab to do an initial cleaning of coils/filters, place stickers/tracking sheets on the units describing what needs to be done for proper maintenance of that unit type, and then meet with the lab contact person to go over how to properly maintain the units and what items were observe that need to be addressed by the lab as soon as possible (such as the defrosting of freezers). After the initial consultation, labs assume responsibility for maintaining their own units and CU Green Labs runs a contest twice a year to check in with labs to see how well the units are being maintained.

If we assume 50 labs sign up for the maintenance program and each of those labs defrost 3 units and clean the coils on 5 units, then the total comes to \$2950.

\$2835 for gift cards to SUPPLEMENT key categories in the refrigerator/freezer retirement or replacement offerings funded by the Facilities Management Office of Resource Conservation (FMORC) for old and inefficient laboratory units (see appendix B for the funding that will be offered again during the contest through the FMORC). To qualify, units must be currently in use by lab, in good working order, and 10 ft³ or larger in size.

- \$100 per ULT freezer unplugged for one year
- \$50 per multiple glass door refrigerator replaced with a new Energy Star residential style refrigerator
- \$25 per refrigerator retired (1990 or older, with commitment to not replace for 2 years)
- \$40 per single glass door refrigerator retired (any year, with commitment to not replace for 2 years)
- \$80 per multiple glass door refrigerator retired (any year, with commitment to not replace for 2 years)
- \$35 per -20°C freezer retired (1990 or older, with commitment to not replace for 2 years)
- \$75 per -30 or -40°C freezer retired (2000 or older, with commitment to not replace for 2 years)
- \$200 per ULT freezer retired (with commitment to not replace for 2 years)

Justification: In the fall of 2010, the program show in Appendix B was offered to labs to retire or replace their old, inefficient refrigerators and freezers. The program which offered incentive funds plus free disposal will result in the removal of 29 inefficient units from campus by the end of February or early March. As part of the freezer week contest, this program will be offered again campus wide. However, to increase participation, CU Green Labs would like to supplement the funding offered by the FMORC by also offering the lab members gift cards at the values described above. All the gift card values above are set at less than 6 months of energy consumption for each particular type of refrigerator or freezer unit with most at 4 months or less. If two ULT freezers are unplugged for one year, 4 multiple glass door refrigerators replaced with Energy Star Refrigerators, 25 refrigerators are retired, 3 single glass door refrigerators are retired, 4 multiple glass door refrigerators are retired, 12 freezers at -20°C are retired, 2 freezers at -30 or -40°C are retired, and 4 ULT freezers retired, that comes to \$2835 in gift card incentives.

\$700 for sharing in combination with retiring or unplugging a unit

- \$75/case where a new situation of sharing is set-up for an ULT freezer in combination with a commitment to unplug another ULT freezer for a year (this incentive will be added to the \$100 incentive to unplug a ULT freezer for a year)
- \$150/case where a new situation of sharing is set-up with an ULT freezer in combination with retirement of another ULT freezer (this incentive will be added to the incentives received for retiring an ULT freezer)
- \$25/case where a new situation of sharing is set-up with all other full size freezer types in combination with retirement of a freezer or refrigerator/freezer (this incentive will be added to the incentives received for retiring a freezer or refrigerator/freezer combination unit) or a commitment to unplug a freezer or refrigerator for a year.

Justification: When I worked in Biochemistry, we had a full size ULT freezer that was just over half full for most of the years I was there. We could have easily shared that space with another lab and prevented an entire ULT freezer from being in use. An atmosphere of sharing to reduce the number of ULT freezers on campus really needs to be promoted which is why offering this gift card incentive would be worthwhile. If 4 ULT freezers are unplugged for a year, one ULT freezer retired, and 10 freezers of other types unplugged or retired, that comes to a total of \$700.

\$200 Grand Prize Gift Card and Certificate for CU-Boulder Lab who accumulates the most points in national contest

Justification: To help CU-Boulder win the national contest, there is a need to set up a competitive spirit on campus for the most points earned by a single lab in the contest. The point system being set-up by UC-Davis will be provided to the CU-Boulder labs. On CU-Boulder campus, this award will also have a fun name and the winner of the award will be announced to the entire CU-Boulder campus.

FOOD: \$2210 for pizza and drinks: For those labs participating in the contest, lunch will be provided on their assigned freezer clean-out day. If we have 100 lab participating with 10 people per lab on average, that is 1000 people. If a pizza from Dominos on Broadway will feed three people and costs \$6.50 each, then the total for pizza will be \$2167. If we add ~\$43 for drinks (people will need to bring their own reusable cups), then the total comes to \$2210.

INVENTORYING SOFTWARE: \$4500 for software to be used for freezer inventorying: For those labs who would like to inventory their freezers with the use of software, \$150/lab will be provided towards the cost of the software for the first 30 labs who sign up. Typical software programs used to inventory freezers include: Filemaker Pro, FreezerWorks, FreezerPro, EZFreezer, & SampleWare (Biomatrica); and cost anywhere from \$230 to \$500. The lab will be responsible for paying for the entire software up front and then will be reimbursed the \$150 incentive after the software has been loaded onto a lab computer and inventorying has begun.

Other Sources Contributing to the Contest:

FACILITIES MANAGEMENT OFFICE OF RESOURCE CONSERVATION FUNDING: In the Fall of 2010, the program show in Appendix B was offered to labs to retire or replace their old, inefficient refrigerators and freezers. The program which offered incentive dollars plus free disposal will result in the removal of 29 inefficient units from campus by the end of Feb or early March. As part of the freezer week contest in April, Moe Tabrizi has offered funding from the Office of Resource Conservation to again bring these incentives in Appendix B to the labs to get rid of inefficient refrigerators and freezers. In combination with the contest and the gift cards budgeted above to supplement some of the incentives categories shown in Appendix B, I believe we could remove up to 90 additional units from campus in this second round which would require a similar level of funding (or more) from the Office of Resource Conservation to what is being requested in total from Sustainable CU in this proposal.

ENVIRONMENTAL HEALTH AND SAFETY (EH&S): EH&S has committed to being available and even present to offer hands on help during the freezer contest week to labs to make sure hazardous materials and unknown materials leaving campus freezers are handled properly and safely.

QIAGEN DONATION: Our local Qiagen representative, Heather Ferguson, has agreed to provide 100-150 tubes of the Qiasafe DNA product free of charge to labs interested in signing up to test their product as part of the freezer week contest. The Qiasafe DNA tubes allow DNA to be safely stored at room temperature rather than in freezers and thus will ultimately lead to less freezer use in some labs. According to the Qiagen website (<http://www.qiagen.com/products/qiasafednatubesand96-wellplates.aspx#Tabs=t0>), these tubes have a value of \$358-\$537 (at a rate of \$179 per 50 tubes). Heather has also agreed to host a follow-up luncheon (not to exceed \$250) with those labs who tested their product so everyone can share their experiences and discuss when the product is useful and when it is not.

BIOMATRICA DONATION: Walt Pennington at Biomatrica (<http://www.biomatrica.com/>) has offered three tubes of any type of their room temperature storage products to each lab interested in testing out room temperature storage for RNA, Bacterial Clones, Blood Samples used for RNA or DNA extraction, etc. as long as the labs commit to providing results of their tests. Labs testing these samples would also be invited to attend the luncheon hosted by Qiagen to share their experiences.

CU GREEN LABS PROGRAM: Funding and time commitments for all other administrative parts of the contest will be provided by CU Green Labs including promoting/advertising the event, creating the needed Survey Monkey documents for the contest, setting up rooms and delivery of the pizza lunches, being available the week of the contest to check in with labs, doing all the follow-up work after the contest (verifying incentive submissions, getting retired/replaced units disposed off, etc.), meeting with EH&S in preparation for the contest, etc.

Student Involvement: Students will be highly involved since 1) the majority of individuals working in campus laboratories who will be participating in this contest are graduate students and 2) undergraduate students working with CU Green Labs will be helping with the contest and follow-up items after the contest (including getting labs entered into the CU Green Labs maintenance program, helping with the process necessary to get retired/replaced units picked up for disposal by Property Services, etc.).

Timeline: (now through the end of June, 2011)

- 1) Preparations for the contest have already begun
- 2) The actual contest will run from April 4-8, 2011
- 3) Follow-up items including verification of incentive actions taken by lab members, disposing of units submitted for retirement and replacement, and the follow-up luncheon hosted by Qiagen on room temperature storage will be completed by the end of June.
- 4) Other follow-up items which are not part of the items budgeted in this proposal but are still a result of the contest, such as a checking in to see if inventories & labeling systems are being used as promised (possibly via a contest from CU Green Labs) and setting up the maintenance program in the labs that signed up, will likely not be completed until the end of the summer.

Feasibility: Despite the fact that cleaning out and inventorying freezers is viewed as a chore by labs, this is a feasible project since ultimately it is in the labs' best interest to have well organized units and an inventorying system in place to know what and where items are in their freezers. The labs realize this and in many cases just need a push (or incentive) to get the job done. Other action items described in this proposal have also proven to be feasible through efforts that CU Green Labs have previously pursued with labs. For example, the CU Green Labs Program already has a maintenance program in place with more than 20 labs participating, the program also has been successful in getting 6 ULT freezers raised in temperature from -80°C to -70°C, the refrigerator/freezer retirement/replacement program offered in Nov. of 2010 (which is providing free disposal and incentives dollars to the lab, but no gift cards) is in the process of removing 29 inefficient units from the campus, and room temperature storage is successfully being used by labs at other Universities such as Stanford.

Sustainability:

ENVIRONMENTAL IMPACT: This project will be a huge benefit to energy savings on campus in both the short term and long term. Some aspects of the contest such as raising the set-point temperature on ULT freezers, retiring and replacing old and inefficient refrigerators & freezers, and improving the maintenance conditions of units will result in immediate energy savings to the University. Other aspects such as removing unneeded materials from freezers, inventorying & properly labeling samples, testing out room temperature storage of DNA & RNA, gathering information on long term storage of biological samples at temperatures of -70°C or warmer, and sharing of freezer units will result in long term energy savings by working to avoid 1) the need to purchase freezers unnecessarily due to poorly managed freezer space or a lack of sharing between labs and 2) the purchase of freezers at colder temperatures than necessary. If 100 labs participate in the contest in the manner which I have presented in the budget, then I estimate that the contest will result in **200,000 KWH/YR OF ONGOING ENERGY SAVINGS (or ~200,000 LBS CO₂/YR according to carbonify.com) WHEN ONLY TAKING INTO CONSIDERATION THE SHORT TERM ENERGY SAVINGS ASPECTS OF THE CONTEST.** HOWEVER, ONE OF THE MOST IMPORTANT ASPECTS OF THE CONTEST IS THE LONG TERM ENERGY SAVINGS DUE TO IMPROVED RESPONSIBLE USE OF FREEZER SPACE AND ENERGY CONSUMPTION BY CU-BOULDER'S LABS.

ECONOMIC BENEFIT: This project is a benefit economically to many parties on campus. It will save the University energy costs in the short term and long term. It will save the labs costs associated with 1) ordering reagents that the lab already had in a disorganized freezer, 2) time searching for materials in a disorganized freezers, 3) purchasing additional freezers to compensate for inefficiently used freezer space, and 4) replacing and disposing of old, inefficient freezers (and refrigerators). It will save EH&S time (and thus employee resources) by preventing the need to comb through freezers left behind by retired researchers or researchers that have moved on (a service used by lab departments that EH&S currently offers to labs to ensure lab materials are properly disposed of).

SOCIAL BENEFIT: Projects which reduce energy consumption, like this one, are a benefit to the social leg of sustainability since it is the lower income communities that will suffer the most from climate change. Raising awareness about the need for labs to use resources responsibly, such as energy, also benefits the social leg of sustainability by indirectly pointing out to lab members that the decisions made and practices used by labs do have an impact on others.

Project Longevity: As described above under Environmental Impact, this project benefits long term energy savings in numerous ways. However, this project also greatly benefits the cultural change in labs that the CU Green Labs Program is promoting

at CU-Boulder, a change from resource use that is based upon convenience to resource use that is based upon what research actually demands to get the experiments done. This cultural change (in way labs think about resource use) will likely be one of the biggest impacts CU Green Labs has resources conservation at CU-Boulder.

Innovation: The national freezer week contest is the first contest of its kind. CU Green Labs is helping to create the criteria for the contest by providing input to UC-Davis on contest document drafts and helping to write at least one survey monkey document for the national contest. CU-Boulder is also the first campus who has provided details to other campuses nationwide on how the contest will be conducted on our campus, thus providing them with ideas to copy for their campus.

Appendix A: Lab Experiences Supporting the Need for a Laboratory Freezer Week Contest

A TRUE STORY ABOUT A POORLY MAINTAINED ULT FREEZER SET COLDER THAN NECESSARY, WITH LOTS OF EMPTY SPACE THAT COULD BE SHARED, AND HOLDING FORGOTTEN SAMPLES FOR NEARLY TWO DECADES

The lab where I started working in 2000 had a single chest ULT freezer. Like most lab members, at that time, I didn't realize an ULT freezer was such a large consumer of energy. It was never discussed and it never crossed my mind to ask. I was focused on what I had been hired to do...research. During most of the years that I worked in the lab, the freezer was poorly maintained. The filter was rarely cleaned and therefore usually clogged with dust. The lid often did not seal well because of ice buildup. And unlike other tasks around the lab, no one was ever assigned the task of maintaining the freezers and, as a result, no one considered freezer maintenance a job that needed to be done except defrosting our manual defrost -20°C freezer in the summer which would get so much ice that it had to be defrosted to be useful again. But even when we defrosted our -20°C freezer we didn't think to go over and clean the filter on the ULT freezer. It simply was something that no one had ever talked about in lab (regardless of how obvious it should have been to us) and thus we didn't think of doing it. I do believe the filter did get cleaned every couple of years because periodically the next door lab who had another ULT freezer next to our ULT freezer would clean their filter and also do ours at the same time to be neighborly. But, knowing what I know now, it really should have been cleaned every month because it was in a hallway where there was constant flow of foot traffic and lots of dust to kick up. It wasn't until the end of my time in that lab (2005-2007) when, due to my interest in energy savings and through asking questions, the unit became better maintained.

The ULT freezer also had a lot of empty space. Most of the years that I worked there, we really only used or needed half of the freezer and could have easily shared it with a nearby lab. It certainly would have prevented the need for two ULT freezers to serve two labs. But the mentality was that each lab should have their own ULT freezer and so that is just the way it went. We did use the extra space in the ULT freezer when we defrosted our -20°C freezers, but a mobile manual defrost freezer which CU Green Labs is doing a pilot study of, starting this month (Feb), could have easily filled that need.

The ULT freezer was set at -80°C but there was really no reason why it had to be set at -80°C. But all the labs in our division called this type of freezer a "-80°C freezer" (rather than an "Ultra Low Temperature freezer") and therefore the mentality was that -80°C is where they must need to be set. As far as I know, none of the samples we had in the freezer required -80°C. In fact, I was storing samples in the freezer that may have been able to be stored at -20°C. I never completed the experiments to see what temperature my protein really needed to be stored at. Like most researchers, I just assumed that colder must be better for my protein so let's put it in the ULT freezer. But, at the very least, I have no doubt that -70°C, -60°C, and even -40°C would have been just as good as -80°C for storing my protein. After all, all of these temperatures are really cold and the samples are still really frozen.

In the summer of 2004, my husband and I took a vacation from work and hired an Exum guide to climb the Grand Teton in Wyoming. By coincidence, our guide happened to have been a former Ph.D. graduate from the division in the department where I worked. Pete had graduated from CU-Boulder with his Ph.D. in the late 1980s. About two months after our trip, our lab decided to go through our ULT freezer because it was starting to get full (not so much because it was housing a lot of samples that needed to be stored at -80°C, but because, as I described earlier, the freezer had had lots of empty space and thus had become a place where things got placed temporarily and then forgotten about). At one point, our PI pulled out a tower of boxes totaling about 1 ft³ in space with Pete's name written all over them and asked me if I knew who this person was. I was shocked to see the boxes and told our PI that Pete was not going to need those samples anymore. They had been there since the mid to late 1980s and no in the lab even knew they were there or perhaps we had seen them but we were afraid to throw them away because we didn't know who Pete was.

SCENARIO DESCRIBING HOW SAMPLES CAN END UP STORED IN FREEZERS FOR DECADES UNNECESSARILY

Here is a typical scenario, based upon my experience, on how unknown, unneeded materials can end up in freezers for decades:

A lab member is doing a long, time-intensive procedure for the first (and perhaps only) time to purify a cellular product from a cell pellet and saves materials from multiples steps of the procedure in the ULT freezer just in case a mistake was made and the product of interest accidentally ends up in a rinsing step, etc. Since these are materials to be discarded immediately after extraction of the purified product is verified, they are not labeled very well. After finishing the purification, studies are done to verify that the product was indeed collected, but the studies are not very conclusive and thus additional studies need to be done before the extra materials stored in the freezer can be thrown out. Finally experiments indicate that the researcher most likely has the product of interest, but

it is not 100% certain so the researcher hesitates to throw away the extra materials and decides to leave them there just in case s/he needs them later. However, years pass and the lab member has now left the lab to move onto his/her next career step and the materials are still left the freezer. Newer lab members find the materials, but since they were poorly labeled in the first place, the newer lab members do not know exactly what the materials are and are afraid to throw them away in case they could be something of importance. The PI of the lab is really the only person who can make that decision (no other lab members are willing to take such a risk) but the PI, like most PIs, is someone who is so busy that the newer lab members do not want to bother him/her with figuring out whether something should be thrown out or not. So the materials sit longer in the freezer while freezer space in the lab is getting really tight. The PI hears about the need for more freezer space so he puts a line item on his grant for a new ULT freezer (which takes a couple of minutes of time to include on a grant) and waits to see if the proposal is approved. The PI's grant is approved and thus the lab buys a new ULT freezer to alleviate their freezer space problem without having to get rid of the unknown materials in their freezers.

HERE ARE SOME PHOTOS TAKEN IN CU-BOULDER'S LABS. WHILE THESE ARE EXAMPLES OF WORST CASE SITUATIONS, THEY DO SHOW HOW BAD THINGS CAN GET.



Appendix B: Announcement for Refrigerator and Freezer Retirement and Replacement Offers Funded by Facilities Management Office of Resource Conservation

**\$\$\$ to Retire or Replace INEFFICIENT Refrigerators or Freezers in Labs!
Let us help you get rid of your inefficient units.**

To submit a refrigerator or freezer for consideration, go to <http://www.surveymonkey.com/s/VJJKPCS>

All survey monkey submissions must be received **by November 19, 2010**

PLEASE NOTE: *The University of Colorado is expecting to realize energy savings from this program, so please be considerate and only submit those units that fit the criteria and are currently in use in your lab.*

Refrigerator or Freezer Category (for your current unit): <ul style="list-style-type: none"> <i>Units must be greater than 10°Cubic foot *</i> 	BEST INCENTIVE & LWEEP PREFERRED Retire without replacing: <ul style="list-style-type: none"> <i>LWEEP pays 2 yr energy savings***+ disposal cost***</i> <i>Lab commits to not replace unit for 2 yrs****</i> 	2nd BEST INCENTIVE Unit replacement: <ul style="list-style-type: none"> <i>LWEEP pays 2 yr energy savings** + disposal cost***</i> <i>Lab must replace unit with an Energy Star Unit*****</i> 	Other Offer
Refrigerator with freezer, 1990 or older	LWEEP pays: \$150 + disposal cost (\$85)	LWEEP pays: \$100 + disposal (\$85) <i>after lab replaces unit with a new Energy Star refrigerator</i>	
Single glass door refrigerator (any year)	LWEEP pays: \$250 + disposal cost (\$85)	LWEEP pays: \$200 + disposal (\$85) <i>after lab replaces unit with a new Energy Star refrigerator</i>	
Double glass door refrigerator (any year)	LWEEP pays: \$350 + disposal cost (\$85)	LWEEP pays: \$300 + disposal (\$85) <i>after lab replaces unit with a new Energy Star refrigerator</i>	
-20°C freezer, 1990 or older	LWEEP pays: \$200 + disposal cost (\$85)	LWEEP pays: \$125 + disposal (\$85) <i>after lab replaces unit with a new Energy Star freezer</i>	
-30°C or -40°C freezer, 2000 or older	LWEEP pays: \$300 + disposal cost (\$85)	LWEEP pays: \$200 + disposal (\$85) <i>after lab replaces unit with a new Energy Star freezer</i>	
ULT freezer (-60°C to -80°C) (any year)	LWEEP pays: \$1000 + disposal cost (\$85)	No offer available	LWEEP pays: \$200 to unplug for 1 yr**

The fine print:

- *If you have a number of small units (~5 cu. ft.) you would like to retire, please contact Kathy to discuss options.
- **If your submission is approved, funds will be paid directly to the Department where the unit is located but only after 1) the retired unit has been removed from the Department (for the “retire without replacing” option) or 2) the unit to be replaced has been removed from the Department and the new Energy Star Unit is in place in the lab (for the “unit replacement” option) or 3) the year of being unplugged has ended (for the ULT freezer unplug for 1 year option).
- ***LWEEP will coordinate the removal of the inefficient units by Property Services and pay Property Services directly for the removal. However, labs are still responsible for following the proper disposal procedure outlined on the disposal form and for filling out the form.

Forms will be submitted to LWEEP rather than Property Services. To view the form, go to www.colorado.edu/ehs. Under “Quicklinks” select “Equipment Disposal/Resale Form” towards the bottom of page.

- ****If you choose to retire a unit, but then decide you need another unit before the two year commitment has expired, you will simply need to pay back the prorated amount of the incentive to LWEEP.
- *****Presently, refrigerators and freezers with Energy Star Ratings are only available in residential-style units. Thus, this replacement incentive will only be beneficial to your lab if a residential unit will meet your lab’s needs. Residential units are not flammable proof and thus cannot be used to store flammable materials. A sticker stating this fact will be applied to the front of the unit.
- Please note that when replacing units, refrigerators need to be replaced with refrigerators and freezers with freezers. If you lab requires something different, please contact Kathy to discuss options. And, of course, the new units must have an Energy Star rating.
- Current funding is limited and will be directed towards the most inefficient units submitted.
- For your information, refrigerators with manual defrost freezers are no longer being produced by manufacturers.

Examples of Energy Star Units and their prices:

- a) **Refrigerator with Autodefrost freezer top:** \$450-\$500 for a GE® 18.2 Cu. Ft. Top-Freezer Refrigerator Model #: GTH18EBTWW (http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10051&productId=202212438&langId=-1&catalogId=10053&ci_sku=202212438&ci_src=14110944&cm_mmc=shopping-_-googlebase-_-D29X-_-202212438&locStoreNum=1546&marketID=51)
- b) **Manual Defrost -20°C upright freezer:** \$650 for a Whirlpool upright 17.8 cu.ft. manual freezer EV181FZTQ (http://www.lowes.com/pd_18826-46-EV181FZTQ_?PL=1&productId=3240663&cm_mmc=SCE_gps-_-gps-_-gps-_-17.8%20Cu.%20Ft.%20Upright%20Freezer%20ENERGY%20STAR)
- c) **Autodefrost -20°C upright freezer:** \$612-\$720 for a Frigidaire 16.6 Cu. Ft. Upright Freezer Model: FFH17F7HW (http://www.sears.com/shc/s/p_10153_12605_04609541000P?vName=Appliances&cName=Freezers&IceMakers&sName=Upright&sid=I Dx20070921x00003a&ci_src=14110944&ci_sku=04609541000P)

For questions, please contact:

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