FINAL REPORT FOR POLLUTION PREVENTION MINI-GRANTS FOR GREENING OF STATE GOVERNMENT

Updated Sept 24, 2012

Grant Project Title: **CU Green Labs Audit and Conservation Program: MCD Biology Department Pilot Study**

State Agency: University of Colorado at Boulder

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Many thanks to all individuals who played important roles in this project at the University of Colorado-Boulder:

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Many thanks also to State of Colorado Department of Public Health and Environment for the funding to make this project possible.

Report Summary:

In the 2009-2010 fiscal year, the University of Colorado-Boulder (CU-Boulder) used a total of 127,363,667 kWh. 8.3% of that use, or 10,622,268 kWh, was by the Molecular, Cellular and Developmental Biology (MCDB) Department. The CU-Boulder Office of Sustainability, which includes the Facilities Management campus engineers, have shown that large energy savings can be achieved in lab buildings by working on the building ventilation and infrastructure. However, there are also significant energy savings to be had by working with lab members and the equipment that they possess. This report on a lab audit pilot in the MCDB Department demonstrates that point. We achieved the equivalent of ~120 kWh/day saving by working with only 4 labs on energy conservation projects. That is the equivalent of removing 6 houses from the electric grid (assuming 20 kWh/day/house). And there are still additional energy saving projects that could be pursued in these labs. Imagine what results could be achieved with similar efforts across CU-Boulder's estimated 400 laboratories and across research campuses nationwide.

As is true with most conservation efforts involving lab members, CU Green Labs has found that an important factor in success is whether or not the lab members are engaged and willing to make changes for conservation. Labs are specialized environments with special considerations for safety. Thus information on what is possible and what is not possible in a lab often relies on input by the lab member themselves. This certainly is true for lab audits, or what CU Green Labs prefers to call lab assessments (because of its less imposing tone).

It is for these reasons that CU Green Labs proposed to do this pilot lab assessment project with the MCDB department, a department on campus which has proven to be very engaged and involved with the CU Green Labs Program since its creation in 2009. It is also for these reasons that CU Green Labs reached out to some of the more engaged labs in the MCDB Department to participate in the lab assessment pilot.

Below is a chart summarizing the results of the project (NOTE: ULT freezer = Ultra Low Temperature freezer, a.k.a. -80°C freezer). We worked on conservation efforts with four labs (plus some departmental equipment used by these labs). All

purchases were done by June 30, 2012, but we did continue to meter into July to determine the energy saving results of conservation efforts.

Lab Name	Equipment Electrical Consumption* (kWh/day)	Reduction in electrical consumption of equipment (kWh/day)	% reduction in equipment electricity use	Energy Saving Actions Taken
Winey	113	52.5	47%	1) Eliminated need for ULT freezer by sharing 2) Repaired ULT freezer door problem 3) Replaced two inefficient incubators with an energy efficient unit
Xue	166	13.9	8%	1) Unplugged three small incubators 2) Raised temp of two ULT freezers to -70°C 3) Preventative Maintenance check-up on 4 ULT freezers
Hoenger	358	14.7 & ~5.7 for lighting	4%	1) Retired two small refrigerators 2) Repaired ULT freezer and raised temp to -70°C 3) Upgraded server & unplugged unneeded equip. 3) Upgraded from flood lights to LEDs in scope rooms
Olwin	Inefficient time to do complete assessment	27	N/A	1) Retired 5 freezer and refrigerators by discarding samples and consolidating 2) Turning Biosafety Cabinet blowers off at night
Dept equipment	N/A	7.6 & autoclave effort	N/A	1) Raised temp to -70°C and PM of ULT freezers 2)Insulation upgrade on two autoclaves

121	kWh/day	**TOTAL energy savings** (except autoclave savings)
6	Houses	# of equivalent houses if using ~20kWh/day/house

In addition to these above actions for energy conservation (that are explained in more detail within the report body), other deliverables include:

- CU Green Labs Program Lab Assessment Form as well assessment documents from two other campuses to examine and consider
- a review of efforts to divert lab material waste from landfills being used at other campuses nationwide
- signage created by CU Green Labs (posters and sticker)
- information on how to become part of a google group focused on lab conservation efforts and with an associated dropbox containing presentations, posters, stickers and other documents
- a list of useful links for green lab efforts

Background on the CU Green Labs Program at the University of Colorado-Boulder who conducted this project:

Mission: The CU Green Labs Program uses a team approach to minimize the use of energy, water, and material goods in CU-Boulder's ~400 laboratories without compromising research integrity or safety.

Present Funding and Support: The program, which is equally funded and supported by the Office of Sustainability and Environmental Center, also works closely with CU-Boulder's Environmental Health and Safety (EH&S) Department. The program is staffed by one part-time manager (at 60% time) and three student assistants.

The two main focuses of the CU Green Labs Program on campus are to:

1) **Act as a liaison between a) labs & lab departments, b) the Office of Sustainability and Facilities Management, c) EH&S, and d) the Environmental Center:**
   - Ideas for conservation in labs can come from any of these groups (labs, lab depts., EH&S, Environmental Center, Facilities Management, CU Green Labs).
   - CU Green Labs helps facilitate discussion and communication on suggested ideas and projects between necessary parties until the end of the project, until a project is ready to be handed off, or CU Green Labs may manage a project completely until its end depending upon what the project is and what it entails.
2) **Engage scientists in conservation and work with scientists on conservation opportunities in their labs:**
   - *Importantly, the program is creating a campus-wide network of Lab Eco-Leaders*
     - *Definition of a Lab Eco-Leader:* a lab member who cares about resource consumption in laboratories and would like to volunteer to encourage the efficient use of energy water and material goods in his or her lab. This site describes the role in more detail: http://ecenter.colorado.edu/greening-cu/cu-green-labs-program/lab-eco-leader
     - Presently there are ~130 volunteer Lab Eco-Leaders in 16 departments, representing about a third of labs on campus.
   - Outreach to labs and departments includes Eco-Leader meetings (where Eco-Leaders are grouped based upon their science) , posters, presentations, personal contact, emailing, and contests

The CU Green Labs Program also participates in national efforts for greening of scientific laboratories through:

1) Sharing CU Green Labs materials with the Green Labs Google Group, StoreSmart Group, and other contacts
2) Presenting and participating annually at the Lab21 conference, as well other webinar/conference opportunities
3) Collaborating with colleagues at university and government agencies nationwide on items such as green purchasing, best practices for conservation in labs, etc.

Equipment Metering:

Grant funding paid for meters and associated cords needed for metering.

Metering of equipment in this project was done through the use of Kill A Watt meters for small equipment and Elite Pro PS meters for large equipment similar to that described in the following document from Labs21 which CU Green Labs used as a reference:

http://labs21.lbl.gov/wiki/equipment/images/6/6d/Labs21_Equipment_Survey_Protocol_UC_Davis_2010.pdf

- Importantly, we were able to meter large equipment with Elite Pro PS Meters without the need to connect the meter at the electrical box and thus, without the need to hire an electrician. By working with our electrical shop, "pigtail" cords for the various electrical plugs were created (similar to what is described in the link above)

but also including "contact" boxes as an adaptation to what is described for making contacts on page 32 of the Operators Manual for the Elite Pro SP meter.
    - We discovered that this technique only permitted metering of one piece of equipment at a time. As a result, we ended up purchasing three Elite Pro meters. Equipment was metered for 4-14 days.
    - To learn more on how to do this set-up for metering of large equipment, contact Pepper Clayton at pepper.clayton@colorado.edu
- Data for the consumption of electron microscopes was obtained from readings taken from the UPSs at times of various use conditions for the scopes.
- The amount of small equipment located in the labs was extensive and thus we did not meter all equipment, but instead gathered enough information using Kill-A-Watt Meters (and gathering information on-line) that we could provide estimates for the consumption based upon small equipment type and extent of use in the labs. Equipment was metered for 2-7 days.
- There was also equipment in the labs that we were not able to meter (such as autoclaves) due to the complexity of getting that equipment metered.

Assessments of MCDB Pilot Labs

How were labs solicited to participate in the pilot?

- At first, CU Green Labs asked help from a supportive MCDB staff member to send out an email message to their entire department about the opportunity to participate in the pilot. However, no responses were received.
- Next, CU Green Labs simply spoke IN PERSON with the most engaged Lab Eco-Leaders in the MCDB department to see if their lab was willing to participate. With this personal contact approach, CU Green Labs had no problem lining up labs to participate. In fact, CU Green Labs often find that the personal contact approach works much better to engage labs and lab members in conservation efforts than emailing.

Which MCDB Labs Participated?

Completed assessment and conservation efforts with three labs:

- **Winey Lab** is a lab of about 10 members whose research focuses on cell cycle studies of yeast and other organisms. Their research needs involve the use of typical molecular biology equipment (freezers, incubators, biosafety cabinets), supplies, and experimentation.
- **Xue Lab** is a large lab of about 20 members whose research is focused on studying the mechanisms of programmed cell death (or apoptosis) and various human diseases. This lab's research also requires the use of typical molecular biology equipment, supplies, and experimentation.
- **Hoenger Lab** is a lab of about 11-14 members. This lab is a national lab focused on the development of technologies and methods for 3-D imaging of cells with transmission electron microscopy. While research heavily involves the use of electron microscopes, computers and software, the lab does still do typical wet molecular biology experimentation.
    - NOTE: A lab member in the Hoenger Lab explained that labs nationwide (and worldwide) can request to use the electron microscope imaging facility free of charge. Thus, while this lab's and equipment are large consumers, they are serving many labs nationwide (and worldwide) who otherwise might pursue purchasing this specialized equipment for their campus. Therefore, in essence, the facility is contributing to conservation by providing free electron microscope services.

Initial efforts with one additional lab:

- **Olwin Lab** would have been the next lab that CU Green Labs would have assessed, but there was inefficient time to get the work done. However, CU Green Labs did work on efforts with this lab which are well worth including in this report. The Olwin Lab is a lab of about 11 members whose performs skeletal muscle stem cell research involving the use of typical molecular biology experimentation.

Lab Assessment Forms:

Two labs (Winey and Hoenger) completed the requested lab assessment form which can be found at this site:

http://www.colorado.edu/cusustainability/solution/documents/CUGreenLabsProgramLabAssessmentForm02182011.pdf

- Here is one lab member's response to filling out this form as part of this MCDB Lab Assessment Pilot process
  - "we have a lot of equipment. I'm pretty sure we have a fridge or freezer for each person in the lab. This was definitely an eye-opening experience and I'm going to put together a report for our lab members."
- CU Green Lab has been using this form (or a slightly different earlier version) with Lab Eco-Leaders for over two year. While only about 15 labs have filled it out, in general the response has been that lab members had no idea they had so much equipment. Some have even told me that they did not know that some equipment belonged to their lab (equipment that has been sitting "ON" without use).

CU Green Labs has also learned about two other assessment forms and documents that may be of interest:

- The University of California – Davis (UC-Davis) Green Lab Assessment Tool was created by Allen Doyle and is attached. When using this tool, credit should be given to UC-Davis.
- The S-Labs Laboratory Assessment Framework: http://www.goodcampus.org/files/files/64-S-Lab_Lab_Assessment_Framework_final_Sept_2011.pdf

Assessment of small equipment in labs:

- The amount of small equipment in the labs is extensive.
- Some equipment was metered, but not all…only enough so we could gain an understanding of how much equipment of different kinds typically consumes. For example, here are some electrical consumption numbers for small equipment which we obtained from metering results :

Equipment Type	**Conditions**	**typical kWh/day if "ON" 24/7**
Heat block	37°C	0.25
Heat block	55°C	0.35
Heat block	95°C	0.7
Heat block (sand)	100°C	1
Small Tabletop Water bath	37°C	0.25
Large Tabletop Water bath	37°C	0.5
Large Tabletop Water bath	65°C	2
Light Microscope		0.7
Small Tabletop Centrifuge -eppies		0.1
Mid-size Tabletop Centrifuge -eppies		0.25
table tilt mixer		0.01
scale/balance		0.07

- The CU Green Labs assistants did create spreadsheets where we documented all of the small equipment in the labs. (These were not included in this report because of their large size, but can be made available upon request)
    - One benefit from this effort was the opportunity to meet with a lab member to go over their list of smaller equipment so we could determine how often the small equipment was used and how often it was "ON". Labs in general are amazed at how much equipment they have.
        - One lab member specifically stopped me in the hallway to comment on how revealing this exercise was to her; she indicated that she had now idea their lab had so much equipment and that there were many pieces of equipment that could be turned off when not in use.
    - ***However, documenting small equipment was very time intensive process and we question whether it is worth the work to put so much effort into small equipment which in most cases is not among the larger consumers in labs.***
        - **Instead, IF small equipment is going to be assessed, it is our suggestion that**:
            - A simplified list of quick counts of small equipment be created (5 heat blocks at 37°C, 2 heat blocks at boiling temp, 2 waterbaths at 60°C, etc.),
            - Information be collected on how frequently that equipment is "ON" on average
            - And then a total electrical consumption for the small equipment can be estimated via frequency of use information and typical consumption numbers such as those shown in the table above.
        - **Also, the main focus of the assessment with small equipment should be on getting the equipment off** when not in use:
            - Permanently turning off equipment that is not needed (and encouraging equipment retirement or donation)
            - Putting timers on equipment where appropriate (heat blocks, water baths, drying ovens, etc.)
            - Setting up procedures where equipment is turned off when not in use

Estimated Total EQUIPMENT Electrical Consumption for Each Lab Before Energy Saving Actions:

- **Winey Lab Estimated Equipment Electrical Consumption:**

Equipment Type	Make Model	Size/Temp/Other Info	kWh/day if "ON" 24/7	Metered or estimate	% of time equipment "ON"	Actual kWh/day based on use
ULT Freezer Upright	Forma Scientific 8326	~20 cu.ft. at -70°C	20.8	metered	100	20.8
ULT Freezer Upright	Forma Scientific 923	~20 cu.ft. at -70°C	21.2	metered	100	21.2
Incubator (Low Temp)	Fisher Sci. Isotemp 11-680-626	~18 cu.ft. at 30°C	14.6	metered	100	14.6
Incubator (Low Temp)	Fisher Scientific FFU20F9GW3	~18 cu.ft. at 24°C	6.8	metered	100	6.8
Incubator (Low Temp)	Fisher Low temp Incubator	~5 cu.ft. at 30°C	8.2	metered	100	8.2
Incubator (Heating only)	Thermolyne Type: 42000	~5 cu.ft. at 38°C	1.4	metered	100	1.4
Incubator (Heating only)	Thermolyne Type: 41900	~5 cu.ft. at 37°C	0.75	metered	100	0.75
10 Freezers and refrigerators	Various residential style	estimation takes into consideration unit types	15	estimate based on metered data of similar units	100	15
Biosafety Cabinet	NuAire NU-425-400	4 foot	13.4	metered	3	0.4
Ice Machine		Small	2.5	metered	100	2.5
~125 pieces of other equipment surveyed	primarily small equipment			estimate based primarily on metered data of sample equipment	various	20.9

TOTAL kWh/day	**112.5**
# of equivalent houses if using ~20kWh/day/house	5.6

- **Xue Lab Estimated Equipment Electrical Consumption**

Equipment Type	Make Model	Size/Temp/Other Info	kWh/day if "ON" 24/7	Metered or estimate	% of time equipment "ON"	Actual kWh/day based on use
ULT Freezer Upright	Forma Scientific 923	~20 cu.ft. at -80°C	24.8	metered	100	24.8
ULT Freezer Upright	VWR Model #503 (Thermo Fisher Sci.)	~20 cu.ft. at -70°C	14.2	metered	100	14.2
ULT Freezer Chest	VWR Model #5459 (Thermo Forma)	~20 cu.ft. at -80°C	16.1	metered	100	16.1
ULT Freezer Upright	VWR model #5706	~20 cu.ft. at -70°C	13.7	metered	100	13.7
ULT Freezer Upright	Forma Scientific 923	~20 cu.ft. at -70°C	23	estimate	100	23
Incubator (Low Temp)	Fisher Scientific 307C	~18 cu.ft. at 16°C	5.7	estimate	100	5.7
Incubator (Low Temp)	Fisher Scientific 307C	~18 cu.ft. at 20°C	5.7	estimate	100	5.7
Incubator (Low Temp)	Fisher Scientific 11-679-25C	~18 cu.ft. at 14°C	5.7	metered	100	5.7
Incubator (Low Temp)	VWR Scientific Model 2005	~6 cu.ft. at 37°C	2.6	metered	100	2.6
Incubator (Heating only)	American Scientific Products IC-62	~6 cu.ft. at 16°C	1.0	metered	100	1
Incubator (Heating only)	Thermolyne Type: 42000	~5 cu.ft. at 24.7°C	0.1	metered	100	0.1
Incubator (Low Temp)	Fisher Scientific model # 1167925C	~18 cu.ft. at 20°C	5.7	metered	100	5.7
Incubator (Low Temp)	Precision Sci Model #815	~18 cu.ft. at 33.5°C	0.8	metered	100	0.8
Incubator (Low Temp)	Fisher Scientific 11-679-25C	~18 cu.ft. at 10°C	6.6	metered	100	6.6
8 Freezers & refrigerators	Various residential style	estimation takes into consideration unit types	12	estimate based on metered data of similar units	100	12
Chromatography refrig (2 door)	Puffard Hubbard Unitherm	~35 cu.ft. at 4°C	9.9	metered	100	9.9
Ice Machine			4	estimate	100	4
~100 pieces of other equipment surveyed	primarily small equipment			estimate based on metered data of sample equipment	various	14.5
					TOTAL	**166.1**
					# of equivalent houses if using ~20kWh/day/house	8.3

- **Hoenger Lab Estimated Equipment Electrical Consumption**

Equipment Type	Make Model	Size/Temp/Other info	kWh/day if "ON" 24/7	Metered or estimate	% of time equipment "ON"	Actual kWh/day based on use
ULT Freezer Upright	Forma Scientific	~20 cu.ft. at -74°C	16.3	metered	100	16.3
Electron Microscope	Tecnai TF20 FEI with Gatan Ultrascan		36	UPS data	100	36
Electron Microscope	Tecnai TF30 FEI with Gatan Ultrascan		103	UPS data	100	103
Chillers for Tecnai TF20 scope	Haskris Serial number H-A 12822	based on 2250 BTU/hr	33	estimate	100	33
Chillers for Tecnai TF30 scope	Haskris Serial number H-A 12112	based on 2250 BTU/hr	33	estimate	100	33
7 computer workstations	Linux for analyzing scope images	based on 200W avg	33.6	metered	100	33.6
Server, Webserver, Firewall, secondary storage	Dell T410, Dell Poweredge 1900 (bio3e), mummy firewall, RAID	based on 1030W avg	22.9	metered	100	22.9
21 laptops and desktops	Various	based on 75 W avg	37.8	metered	100	37.8
16 Freezers and Refrigerators	Various residential style & one lab grade		20	estimate based on metered data of similar units	100	20
Turbo pump	Pfeiffer Model TMH071P		2	estimate	100	2
Incubator	Fisher Scientific	30°C Isotemp	6	estimate	100	6
Incubator	Thermoscientific 2052 series model 3110	37°C	6	estimate	100	6
Ice Machine			4.1	metered	100	4.1
~130 pieces of other equipment surveyed	primarily small or infrequently used equipment			estimate based on metered data of sample equipment	various	4.6
					TOTAL kWh/day	**358.3**
					# of equivalent houses if using ~20kWh/day/house	17.9

Items of significant energy use not measured or included in consumption totals above: It should be pointed out that there are items of significant energy consumption that we were not able to meter or include in this pilot assessment, but are items which we would like to include in the future:

- HVAC (fume hoods and lab ventilation)- often the most energy intensive aspect of labs
- Environmental Rooms (such as cold and warm rooms)- very large consumers
- Autoclaves- another large consumer
- Lights- individually are small consumers but they add up

Actions Taken For Energy Savings

NOTE: While reductions in energy consumption below are expressed in electrical measurements, it is important to note that electrical consumption reductions also mean reductions in heat rejected by equipment into the labs spaces. Thus, this also means energy savings in terms of a reduced need for ventilation to remove excess heat from the lab spaces.

Winey Lab

- **Eliminated one ULT freezer** by sharing with another lab
  - ***ENERGY SAVINGS OF 20.8 kWh/day***
  - During the lab assessment project, one of the two ULT freezers in the Winey Lab failed (the Forma Scientific 8326).
  - Instead of replacing the unit or having it fixed (which would have been an expensive compressor repair), CU Green Labs found an ULT freezer in the adjacent lab that could the shared.
    - The Klymkowsky Lab in MCDB volunteered half of their chest ULT freezer to the Winey Lab by moving material out of ULT freezer to a -20°C freezer that was no longer needed by another lab
    - The Winey Lab was able to consolidate samples enough so half of an ULT freezer was sufficient space for them.
  - Grant funds paid to properly dispose of the broken ULT freezer unit
  - **INFORMATION TO HIGHTLIGHT RELATED TO THIS EFFORT:**
    - *This was approximately the 5th situation of ULT freezer sharing that CU Green Labs has set up for labs to eliminate the need for an ULT freezer purchase at CU-Boulder (saves energy and saves the lab funds). Thus, there are opportunities out there to be found for sharing.*
    - *This example also goes to show that there are materials in ULT freezers that do not necessarily need such cold temperatures. If those materials could be removed from freezers and placed in energy efficient -20°C Energy Star freezers, there would be great opportunities to consolidate and reduce the number of ULT freezers on research campuses for large energy savings.*
- **Repaired ULT door problem** (and did preventative maintenance check-up on freezer)
  - ***ENERGY SAVINGS OF 9.1 kWh/day***
  - ***43% reduction in electricity use by ULT freezer***
  - The Winey Forma Scientific 923 ULT freezer door was leaking so much cold air that the lab had to do weekly frost clean-outs
  - CU Green Labs hired an ULT freezer Technician from Sercom to repair the freezer and do a preventative maintenance check up on the freezer.
    - Grant funding paid for repair and preventative maintenance check-up on freezer
    - The freezer was metered before and after the repair to determine energy savings
  - **INFORMATION TO HIGHTLIGHT RELATED TO THIS EFFORT:**

        - *We were impressed by how much energy savings resulted from fixing this door. Then again this is an upright where the cold air can pour out of a leaky seal. If this had been a chest freezer, much less most cold air would have escaped in comparison.*
        - *CU Green Labs encourages the use of chest freezes because cold air does not fall out every time the door is opened. Not only is that good for energy savings, but it is also good for samples in the freezers since they are not exposed to a rush of warm air every time the door is opened.*
        - *This example shows how important it is to keep door gaskets or seals in good condition and free of frost, especially on upright freezers.*
- **Replaced two low temperature incubators (set at 30°C) with an energy efficient incubator that only heats**
    - ***ENERGY SAVINGS OF 22.6 kWh/day***
    - ***99% reduction in electricity use to meet lab's incubation needs at 30°C***
    - The lab was using two low temperature incubators at 30°C
        - One was a Fisher Isotemp Incubator of ~18 cu.ft. that metered at 14.6 kWh/day
        - Another was a Fisher Low Temp Incubator of ~5 cu.ft. that metered at 8.2 kWh/day
    - Because the lab was using temperatures sufficiently above room temperature, a heating only incubator would meet their needs
        - A Binder BD-400 14.3 cu.ft. incubator with one port for electrical cords was purchased which, according to the manufacturer, uses 1.35 kWh/day. However, we metered the unit at only 0.23 kWh/day.
        - A combination of grant and lab funding paid for the new incubator
    - Grant funding also paid for disposal of large inefficient incubator
    - The lab will hold on to the smaller incubator, but the unit will remain unplugged, unless there is a real need for another temperature by the lab
    - **<u>INFORMATION TO HIGHTLIGHT RELATED TO THIS EFFORT:</u>**
        - *This example highlighted a new conservation effort to CU Green Labs to address in labs throughout campus...looking for low temperature incubators that are being used for above ambient conditions where a more, energy efficient heating only incubator could serve the same purpose for a fraction of the energy use.*
        - *This example also highlighted how important it is to find low temperature incubators that are more energy efficient for labs that do need below ambient incubating conditions. We were shocked by the consumption of these two incubators when the temperature setting was so close to ambient.*

<u>Xue Lab</u>

- **Unplugged or turned OFF three small incubators which were not being used**
    - ***ENERGY SAVINGS OF 3.7 kWh/day***
    - The three units were metered at:
        - 2.6 kWh/day for a VWR Scientific Model 2005 at 37°C
        - 1.0 kWh/day for a American Scientific Products IC-62 at 16°C
        - 0.1 kWh/day for a Thermolyne Type 42000 at 24.7^{o}C
    - **<u>INFORMATION TO HIGHTLIGHT RELATED TO THIS EFFORT:</u>**
        - *It is not uncommon to find equipment "ON" in labs when not in use, even equipment that could easily be shut down between uses.*
        - *Over the past three years, CU Green Labs has had great success with getting equipment off either by the use of timers (when appropriate) or by having lab members manually turn the equipment off between uses. Items have ranged from small equipment such as heat blocks to energy intense equipment such as drying ovens and diffusion vacuum pumps.*

- **Raised the temperature of two ULT freezers from -80°C to -70°C and did preventative maintenance check-ups on 4 out of 5 ULT freezers**
    - ***ENERGY SAVINGS OF 10.2 kWh/day***
    - ***11% reduction in electricity use by 5 ULT freezers***
    - The lab had previously raised the temp of 3 of 5 ULT freezer to -70°C from -80°C (as part of a previous campaign by CU Green Labs) but did not know how to raise the temp of the last two units
    - CU Green Labs hired Sercom to do preventative maintenance (PM) check-up on 4 out of 5 freezers and to change the temperature settings on the two units
        - Metering was done on the freezers before and after
        - The reason PMs were only done on 4 rather than all 5 units is because we did not have the proper cord to meter one unit.
        - Grant funding paid for the work by Sercom
    - Electrical consumption on two units stayed essentially the same
    - Electrical consumption on one unit (VWR Model #5459 (Thermo Forma)) decreased from 16.1 kWh/day to 14.1 kWh/day.
        - This unit had the temperature raised from -80°C to -70°C
        - 2-4 kWh/day is the typical energy savings we see when raising from -80°C to -70°C
        - Thus the energy savings are expected to be the result of the freezer temperature change and not the PM
    - Electrical consumption of another unit (Forma Scientific -86 freezer Model 923) decreased from 24.8 kWh/day to 16.6 kWh/day.
        - The unit was again one which had the temperature raised from -80°C to -70°C
        - 2-4 kWh/day is the expected energy savings seen when raising from -80°C to -70°C
        - Thus, we expect that some of the energy savings was due to the PM.
    - **<u>INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:</u>**
        - *30% of all ULT freezers at CU-Boulder are at -70°C or warmer and the number of ULT freezers at -70°C, rather than -80°C, continue to grow on campus.*
        - *This example points out how important it is for CU Green Labs to offer to do the temperature changes for labs on their ULT freezers when they want them raised. This lab was willing to raise the temperature at least a year before but it never happened for two units because it was difficult to know how to change the temperature.*
        - *For those scientists who are willing to re-consider their freezer temperature selection, CU Green Labs has created a database with information on samples that CU-Boulder and UC-Davis scientists are storing at temperatures of -70°C or warmer and for what periods of time. To access the database, go to http://ecenter.colorado.edu/greenlabs and click on one of the blue buttons at the top of the page.*

<u>Hoenger Lab</u>

- **Retired two small dorm refrigerators**
    - ***ENERGY SAVINGS OF 1.5 kWh/day***
    - The two units were metered at:
        - Kenmore model 564.9143110, 0.6 kWh/day
        - Montgomery Ward LGS-1010A, 0.9 kWh/day
    - Grant funding paid for the proper disposal of these two units
    - **<u>INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:</u>**

        - *Dorm size refrigerators and freezers are great units to retire because they tend to use more energy per cubic foot than full size units do (typically 2x the energy per cubic foot).*
- **Raised temperature on ULT freezer from -74°C to -70°C and repaired freezer relay problem discovered during freezer PM**
    - ***ENERGY SAVINGS OF 3.4 kWh/day***
    - ***21% reduction in electricity use by ULT freezer***
    - During a PM of this freezer, Sercom discovered a relay problem which was causing the freezer's compressor to run nonstop.
        - This not only was causing the freezer to consume more energy than necessary, but it also would is a sign of a likely compressor failure in the future if left unfixed.
            - The repair to the relay only cost less than $500, but would have cost on the order of $4000-$5000 if it had turned into a compressor repair.
        - Grant funding paid for the temperature change and PM
        - A combination of lab and grant funding paid for the freezer repair
    - **<u>INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:</u>**
        - *This example goes to show that just because a freezer is maintaining temperature, does not mean that it is without problems.*
        - *If it had not been for the preventative maintenance check-up, the problem with this freezer may have gone undetected until the unit failed.*
        - *The KLATU Traxx monitoring product described in the Future Efforts below section would have been able to catch this problem with the freezer.*
- **Server Room Changes for Energy Savings:**
    - ***ENERGY SAVINGS OF 9.8 kWh/day***
    - ***This represents a 43% reduction in the lab's server room electrical consumption and 10% reduction of the lab's overall computer-related electrical consumption.***
    - Upgraded firewall to more efficient unit, saving 2 kWh/day
        - Previous unit used 120W on average or 2.9 kWh/day
        - New unit uses 35W on average or 0.9 kWh/day
    - Upgraded web server to more efficient unit, saving 2.9 kWh/day
        - Previous unit used 185W on average, or 4.44 kWh/day
        - New unit uses 65W on avareage, or 1.56 kWh/day
    - Disconnected RAID box no longer needed, saving 4.9 kWh/day (average of 205W)
    - Grant funding paid for part of the energy efficient web server
- **Replaced Dimmable Halogen Floodlights in Electron Microscope Rooms with Dimmable LED Lights**
    - ***ENERGY SAVINGS OF ESTIMATED 5.7 kWh/day***
    - Electron microscope rooms had twelve 100W GE Halogen Flood Track Lights
        - Assuming 5 hours of use per day at 100W, total electrical consumption comes to 6 kWh/day
    - Nichia NVSL219AT-H3 LED bulbs could simply screw into the existing fixtures
        - According to the specification sheet at http://www.nichia.co.jp/specification/en/product/led/NVSL219A-H3-E.pdf, these LED lights use only 5.25W
        - Assuming 5 hours of use per day, total electrical consumption comes to 0.3 kWh/day
        - Grant funding paid for 12 LED lights

<u>Olwin Lab</u>- even though there was not enough time to do a complete lab assessment with the Olwin Lab, CU Green Labs did work on efforts with this lab that are reported below

- **Retired five freezer and refrigerators by discarding unneeded samples and consolidating**
  - ***ENERGY SAVINGS OF ESTIMATED 15.5 kWh/day*** (based upon metering of similar units)
  - The Olwin Lab discarded enough freezer and refrigerator samples to permanently retire the following units:
    - Double door chromatography fridge: True Refrigerators Model T49G, ~49 cubic feet, estimated at 9 kWh/day based on metering of similar equipment
    - Refrigerator/freezer combo unit: 1992 White Westinghouse frost free – Model RT216PCW0, estimated 2 kWh/day based on metering of similar equipment
    - Full Size -20°C freezer: 1996 Kenmore Model 253-926-0210, ~16 cu. ft., estimated 3 kWh/day based on metering of similar equipment
    - Small refrigerator: Frigidaire Coldspot, 8 cu. ft., estimated 1 kWh/day
    - Dorm refrigerator: Kenmore 461-95332 refrigerator, estimated 0.5 kWh/day
  - Grant paid for proper disposal of 5 retired units
  - In addition, the lab defrosted three other units and purchased software to inventory their remaining 2 ULT freezer, 5 freezers, and 2 refirgerator/freezer combos.
  - **<u>INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:</u>**
    - *Based upon discussions with colleagues and working experiences with labs, CU Green Labs estimates that perhaps as much as 30% of samples in lab freezers on research campuses such as CU-Boulder are expired, cannot be identified (because of poor labeling), or are no longer needed. This can lead to the purchase of additional freezers unnecessarily.*
    - *However, cleaning out lab freezers is a cold and thankless job…which is why CU Green Labs has participated in the National Freezer Challenge for the past two year and will continue to do so. Competing between universities and government research campuses gives lab freezer cleanouts a purpose and much more fun spin.*
- **Two Biosafety Cabinets (BSCs) OFF at night for 14 hours when not in use (blowers and light off)**
  - ***ENERGY SAVINGS OF 11.7 kWh/day***
  - The lab previously left the two BSCs "ON", but are now turning them off at night
  - We metered the two cabinets to determine the energy savings reported above:
    - NuAire NU- 425-400, 4 ft BSC, metered at 11.1 kWh/day when ON 24/7 with a new filter in place
    - Baker SG-600, 6 ft BSC, metered at 18.8 kWh/day when ON 24/7 with a new filter in place
  - **<u>INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:</u>**
    - *The metering results on the BSCs demonstrated that the effort to get BSC blowers off when not in use, that CU Green Labs has been encouraging for years, is well worth the energy savings.*
    - *CU Green Labs Program colleagues in labs at the CDC in Atlanta also turn their BSC blowers off when not in use in Biosafety Level labs of 1 and 2 at least.*
    - *Lastly, NIH no longer recommends or supports the use of UV lights in BSCs. Here is a link with information(read the NOTE below Table 1):* http://www.ors.od.nih.gov/sr/dohs/BioSafety/decon/Pages/decontamination.aspx
    - *CU Green Labs will be working on signage (in collaboration with CU-Boulder EH&S) to post on BSCs throughout campus promoting this conservation effort and describing how to safely turn blowers off and on. It will also include information on why UV lights are no longer recommended.*

Efforts on Departmental Equipment Used by Participating Labs in Lab Assessment

- **Preventative Maintenance Check-up on the two back-ULT freezers for the MCDB department and raising the temperature on one from -83°C to -70°C**
  - ***ENERGY SAVINGS OF 7.6 kWh/day***
  - Electrical consumption of the Revco Thermo Electron Corp. Mod. ULT2090-5-D33 (Chest ULT freezer) decreased from 13.3 kWh/day to 12.9 kWh/day after a PM on the freezer (this unit was already set at -70°C
  - Electrical consumption of the Forma Scientific Biofreezer, Mod. 8326 Serial #81937 (Upright ULT freezer) decreased from 21.8 kWh/day to 14.6 kWh/day when decreasing the temperature from -83°C to -70°C and doing a partial PM on the unit (at -83°C, the freezers compressors never shut off).
  - Grant funding paid for the PMs on the units.
  - **INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:**
    - *The large drop in electrical consumption when the freezer was raised from -83°C to -70°C can be explained by the fact that energy consumption on the ULT freezers tend to increase quickly at temperatures lower than -80°C or -75°C. This can be seen in the lower graph of an ULT freezer at this site: http://labs21.lbl.gov/wiki/equipment/index.php/Dometic_Water_Cooled_UP_755G*
    - *Thus while there are great energy savings to be had by raising the temperature of ULT freezer from -80°C to -70°C, there are much greater savings to be had by raising the temperature of ULT freezer to -70°C from temperatures lower than -80°C.*
    - *Furthermore, for back-up ULT freezers, instead of keeping the units plugged in, one alternative is to put dry ice in a ULT freezer when there is a failure until the back-up unit can be plugged in and cooled down. Here is a story of a freezer that made it through a fire where all sample survived with help from some dry ice: https://sites.google.com/site/labfreezercompetitioncuboulder/good-management/details-on-unplugging-ult-freezer-committment*
- **Insulation upgrade on two department autoclaves** (one used extensively by the Xue Lab and another where the Winey Lab is essentially the only user).
  - ***ENERGY SAVINGS UNKNOWN BUT EXPECTED TO BE SIGNIFICANT***
  - The two autoclaves which received insulation upgrades around their ovens are hardwired and connected to house steam. Thus, we were unable to easily meter the units to determine energy savings.
  - However, to give you a sense of what poor shape the insulation was in: two years ago, on another MCDB unit of the same kind (and same installation date), heat from the oven melted the electrical wiring of the unit.
  - Below is a before and after picture of one of the two insulation upgrades paid for by the grant.
  - **INFORMATION TO HIGHLIGHT RELATED TO THIS EFFORT:**
    - *In addition to upgrading autoclave insulation for energy savings, another more simple energy saving tactic is set the autoclaves to go automatically go into sleepmode when there is a lack of use. Or, if that option is not available on your autoclave, then have the autoclave timed to go off in the evenings and on the weekends.*

Photos before (top) and after (bottom) insulation upgrade on 3rd floor MCDB autoclave used extensively by the Xue Lab.

Water Conservation

In the assessment project, CU Green Labs did not find additional water conservation projects other than those that had already been implemented by CU-Boulder Facilities Management over recent years:

- Low flow aerators on laboratory sink faucets
    - In research labs we are using 1.5 gpm aerators and 1 gpm aerators in teaching labs
    - While not all lab faucets are appropriate for low flow aerators because labs are using them to fill containers with water, most labs only use lab sinks to wash hands and dishes which is compatible with low flow aerators.
    - In many cases at CU-Boulder, low flow aerators have been a benefit to labs because they stop the "splashing" problem experienced by lab members at lab sinks.
- Water misers on autoclaves
    - reduced water use from ~45 gallons per hour per autoclave at CU-Boulder to close to nothing, without affecting the function of the autoclave
    - http://www.sterilizer.net/cecweb_007.htm
    - http://alumni.stanford.edu/get/page/magazine/article/?article_id=31983
- Cold rooms and electron microscope chillers on processed chilled water for cooling compressors rather than tap water (2.1 million gallons of water per year for each cold room and 500,000 gallons of water per year saved for the electron microscope chillers).

Zero Waste Efforts

Lots of single use materials: Biological labs are large material waste generators, especially resulting from the extensive amount of single use materials that flow through the labs, such as single use plastics (surgical pipets, pipet tips, pipet tip boxes, petri dishes, cell culture flasks, filtration flasks), gloves, shipping foam coolers, paper towels, and chemical bottles. Many of the single use products are used in labs to meet cleanliness and sterility needs for research.

CU Green Labs receives more requests from Lab Eco-Leaders to address items in the material waste stream leaving their labs than energy and water conservation requests. In the opinion of CU Green Labs, this is because it is such a visual of the environmental impact of research. Energy does not pile up in the corner of the lab nor does water, but material waste from lab experimentation does.

- ***Foam recycling at CU-Boulder:*** Because Eco-cycle, Boulder's local recycler, had foam recycling available through their CHaRM facility, CU Green Labs was able to establish foam recycling in January of 2011, which is now available to labs campus wide.
- ***Pilot of pipet tip box recycling looking promising:*** After years of work, it appears that Eco-cycle may have a local source interested in #5 PP plastic from pipet tip boxes. If all goes well, a pilot for collection and recycling of this material will be set up as early as mid-October. However, Eco-cycle has made it clear that this is just a pilot and there are no promises for on-going collection.
- ***Expansion to address other materials:*** CU Green Labs will continue to expand to address other lab materials in the waste stream. Our next focus will likely be on chemical bottles.

Information collected on what other campuses are doing for conservation efforts to address lab specific waste: Since there is so little in place to address waste stream items from labs in Boulder, for this assessment pilot, CU Green Labs focused its time and energy on collecting information on what other campuses are already doing nationwide.

1) **Biohazardous plastic recycling pilot at CDC in Atlanta (SOP attached)**: CDC has a pilot in place for recycling rigid biohazardous waste plastics. Two biohazardous waste bags are set up in the lab, one for rigid plastics to be recycled (labeled appropriately) and one for all other materials. The bags are autoclaved to disinfect. Autoclave tape (or another indicator showing proof of autoclaving) is left on the bags until the bags are opened in front of

the recycler (Emory University) and the material is then taken for recycling. http://i2sl.org/labs21/conference/2011/abstracts/f6_smith.html

2) **Chemical Bottle Recycling at NIH in Bethesda**: According to Charlyn Lee at NIH, "collection totes for the empty chemical bottles must be stored in the lab. Lids must be placed on the empty bottles. All empty chemical bottles are collected from the labs by our chemical waste contractors who are trained chemists. They perform sorting and processing at our Hazardous Waste Facility. Almost all empty glass, aluminum and plastic, chemical bottles in the lab are recycled. This includes all containers that previously contained chemicals (liquid or solid), buffer and saline solutions, and other miscellaneous products. We do not recycle bottles that previously contained RCRA P-listed waste, infectious material or radioactive material." After processing, chemical bottles are mixed in with typical campus recycling at the Solid Waste and Recycling Facility before shipping the items off campus. http://nems.nih.gov/programs/WM/Documents/Empty_Chemical_Bottles_Recycling_Article.pdf; http://nems.nih.gov/programs/WM/Documents/EMPTY_CHEMICAL_BOTTLES_RECYCLING.pdf; http://www.nems.nih.gov/teams/Documents/Chemical%20Bottles.pdf

3) **Amorette Getty at University of California-Santa Barbara provided the following summary to the Green Labs Planning Group on chemical bottle recycling at various University campuses:** UC- Davis (and Princeton) are doing glass bottle only recycling, while Yale, MIT, and PSU doing glass, plastic, and metal.
    a. MIT require triple-rinsing (with one or all rinse waters treated as hazmat), and usually a label defacing. Acid/Base containers, highly toxic, etc. are often not accepted and sent to EH&S for disposal. . No acutely hazardous or p-listed material. Place in recycling bin. Recent problem with thinner bin liners breaking under the weight, partially solved with dedicated 95G toters on some floors. In most cases, in-lab bins are provided and emptied by custodial staff; in other cases, in-corridor bins are used. http://web.mit.edu/facilities/environmental/lab_recycling.pdf
    b. Princeton: Glass bottles only. Triple-rinse, air dry, cap-less. some solvents can just be air dried. Acutely hazardous bottles to EH&S, all others recyclable. 20-gallon rubber containers with half-lids provided to collect recyclable glass, or a box labeled ' recyclable glass' can be placed in the hallway for custodial staff to remove http://web.princeton.edu/sites/ehs/chemwaste/mtcontainers.htm
    c. Pennsylvania State University (PSU): Glass, plastic. Triple-rinse (collecting one or more rinse waters as hazmat), air-dry, and require bottles to be capless for disposal. Apply 'Empty' labels to be placed on bottles and deface chemical label. Provided in-lab bins for recycling of bottles. Acutely hazardous bottles collect all three rinse waters, then recycle. Custodial staff then empties the in-lab bins. www.ehs.psu.edu/hazmat/**recycling**_chem_**containers**.pdf
    d. Yale has a voluntary pilot program for some labs only: http://recycling.yale.edu/lab-recycling. Triple rinse and deface, place in provided bin, which is checked by a designated lab member for safety before transferring to corridor bin. Acid/Base and acutely hazardous not recyclable.
    e. Columbia: Rinse and label deface, leave capped. Highly toxic, pyrophoric, or water reactive bottles to EH&S for disposal. Bin provided for recycling. All bottles are coded in a campus-wide chemical tracking system and thus must be removed from inventory before recycling. http://www.ehs.columbia.edu/ChemContDisPolicy.html
    f. University of Washington only allows recycling of a sort list of chemical containers:acetone, alcohols, hexanes, toluene, xylene, nontoxic buffer and salts, sugars, nutrients, cleaning products. http://www.ehs.washington.edu/epowaste/trashcontainer.shtm

4) **University of California-Santa Barbara Waste Audit Guide to Laboratory Buildings (attached):**
    - This audit guide looks at all material waste from a lab building except for chemical and biohazardous waste.

Signage Efforts During Course of Grant

- A sticker was created for posting metering information on large equipment that has been metered (attached)
- Three 11x17 color posters were also created on the subject of laboratory freezers (attached)
    - One about raising the temperature of ULT freezers from -80°C to -70°C

- One asking labs to not choose freezer temperatures colder than what their samples need
- One advertising a mobile-20°C manual defrost freezer available for labs to borrow when defrosting or cleaning out their lab freezer (we now have three of these campus-wide).
- *CU Green Labs has found posters to be one of our best ways to communicate conservation messages to lab members.*

Plexiglass 11x17" poster holders (http://www.displays2go.com/Product.aspx?ID=5745) were purchased with grant funds to use in the MCDB dept. 3M Command products, which are strong and removable without leaving a mark, are being used to display the plexiglass holders.

- 3M Command Sticky Nail Wire Back Hangers
  - http://ibuyofficesupply.com/Products/Command-Sticky-Nail-Wire-Back-Hanger__MMM17048.aspx?utm_medium=shopping_engine&utm_source=google&gclid=COu3v86kg7ICFSXhQgodLRAAAQ
- 3M Command Small Picture Hanging Strips
  - http://www.amazon.com/3M-Command-Picture-Hanging-8-Strip/dp/B000T2P7YS/ref=sr_1_6?ie=UTF8&qid=1345915174&sr=8-6&keywords=3M+Command+picture

Plexiglass holders come with many benefits:

- Much nicer presentation and protection of posters
- Establishes locations where CU Green Labs posters should be hung with departmental permission
- Facilitates hanging of posters as CU Green Labs creates new posters to replace older posters
  - CU Green Labs plans to constantly produce new posters with new messages. Our list of ideas is already quite long and it is not expected that we will run out of ideas for posters.
  - The next set of posters we have coming out are on green purchasing, spending grant dollars greenly, and using lab space efficiently.
  - All of the signage we have created so far can be found on the drop box associated with the Green Labs Planning Group mentioned under "Additional Resources for Green Lab Efforts" below.

Environmental and public health benefits from MCDB Lab Assessment Pilot

Global warming is upon us and the expected impacts include frightening threats to both environmental and public health. Scientific labs are large consumers of resources, typically consuming 5-10 times the energy of classroom or office space. In fact, a 2010-2011 study by CU-Boulder Facilities Management Office of Sustainability found that laboratories at CU-Boulder occupy 20% of the square footage of campus, but consume about 43% of campus energy. Direct energy use by labs and use for the manufacture, transport, & disposal of lab products still relies heavily on fossil fuel burning. Thus, anything that can be done to minimize resource use in labs and therefore minimize contribution to global warming is of benefit to environmental and public health. The results of this report demonstrate that there large conservation opportunities to be identified and implemented in labs through lab assessments. Furthermore, some opportunities discovered can be copied in other labs with similar equipment and thus can have reaching impacts beyond just one lab.

Future efforts to explore with MCDB Labs

During the lab assessment project other opportunities for conservation were identified which we were not implemented for various reasons such time constraints, funding constraints, lack of lab commitment at the time, and because the opportunity could not be implemented at the time.

Projects that were identified that perhaps could be pursued in the future if more funding becomes available to CU Green Labs include:

- ***Pilot test of monitoring 10-20 ULT freezers with the use of KLATU Traxx which monitors temperature and energy consumption*** (http://www.klatunetworks.com/products)
    - Presently monitors are being set up on the ~150 ULT freezers across CU-Boulder campus to minimize the risk of loss of precious research samples. However, these monitors, like all other products of this type on the market (except Traxx) only monitor freezer temperature.
    - The KLATU Traxx pdouct is a fairly new product of about 5 years that not only monitors ULT freezer temperature, but also energy consumption.
    - A recent study by KLATU showed that of 34 ULT freezers (that were well cared for including two preventative maintenance check-ups per year and were demonstrating no problems with maintaining temperature), 21% of the freezers had issues (receiving a score of "C" or "F") and were causing the equipment to use more energy than necessary. These assets were using a total of ~$2750-$3500 more in energy than they should have been.
        - Of course, this also means that the freezers were not performing well and stress was likely being placed on the compressors that may lead to a much more expensive repair, a freezer failure at an inopportune time (such as the middle of the night) or at least shorted freezer life.
- ***Replacement of Chromatography refrigerator (9.9 kWh/day) in Xue Lab with an Energy Star residential refrigerator(~1 kWh/day)***
    - ***ENERGY SAVINGS OF nearly 9 kWh/day***
    - Also, look for other similar situations where chromatography refrigerators (large consumers) are not being used as intended for chromatography purposes in other labs
- ***Take advantage of the upcoming air rebalance of one of the MCDB Department buildings***
    - move large equipment in hallways and labs into equipment rooms
    - That way the ventilation rate can be raised in a small equipment room (much more energy efficient) to address the heat rejection problem rather than in larger lab or hallway space
- ***Purchase of water-cooled ULT freezer as a pilot to replace a unit that rejects heat into the space***
    - This would be better to try out in the new Biotech building on campus where there is very reliable processed chilled water.
    - Water is a much more efficient way to remove heat from equipment than the use of room ventilation when equipment is located within lab space (instead of in a freezer farm)

Lastly, I would like to point out that there is a project underway to allow the Hoenger Lab's 7 Linux workstation to go into sleep mode when not in use:

- ***ENERGY SAVING WILL BE ~25 kWh/day for these 7 workstations***
- This project is being pursued by CU-Boulder IT to allow stations like these throughout campus to go into sleep mode.

Additional Resources for Green Lab Efforts

Google group of over 100 members from campuses across the nation (and beyond) interested in collaborating on green lab efforts:

- To join the Green Labs Planning Google Groups with over 100 members, go to the following link and apply for membership: https://groups.google.com/forum/?fromgroups#!forum/green-labs-planning

- The Drop Box (LabRATS Public) associated with this Google group contains powerpoint presentation files, poster files, sticker files, and many other documents from CU Green Labs as well as from other group members. Simply request access to the dropbox by emailing the Green Labs Google Group after you have joined. The dropbox website is at: www.dropbox.com

Here are a number of useful links for conservation efforts in labs:

- Labs for the 21st century website: http://www.labs21century.gov/
- Univ. of California-Davis StoreSmart site: http://sustainability.ucdavis.edu/action/conserve_energy/store_smart.html
- Univ. of California- Santa Barbara LabRATS site http://www.sustainability.ucsb.edu/labrats/
- Univ. of Colorado-Boulder Green Labs Program site: http://ecenter.colorado.edu/greenlabs
- National Lab Freezer Challenge Site: https://sites.google.com/site/labfreezercompetitioncuboulder/
- Harvard Green Labs Site: http://www.green.harvard.edu/labs
- Labs 21 Residential Freezer Wiki: http://labs21.lbl.gov/wiki/equipment/index.php/Recommended_Residential_Freezers
- Labs 21 Lab Equipment Energy Wiki: http://labs21.lbl.gov/wiki/equipment/index.php/Energy_Efficient_Laboratory_Equipment_Wiki
- MIT Green Chemistry Alternatives Wizard: http://ehs.mit.edu/greenchem/

LabRATS (Laboratory Research And Technical Staff)
Waste Audit Guide for Laboratory Buildings
Updated 12/9/08

Disclaimer: This is a record of how the LabRATS (Laboratory Research And Technical Staff) Program performs waste audits. This is not a UCSB campus-wide policy nor the standard for the campus. Please feel free to read, share, adapt, and use this policy as you see fit. The purpose of this document is to share how the LabRATS Program conducts waste audits in a way that others may learn from it.

What (Summary):
A waste audit helps to collect information on waste that a building generates, such as how much waste is produced, how much of each type (trash vs. recyclables), and whether building users put waste in the proper disposal bin. The waste audit takes inventory of the waste produced during a set period of time (typically a 2 day period).

In a laboratory waste audit, it is best to investigate the waste in the nearest dumpster, as well as the waste from receptacles/bins in the building. Researchers often dispose of materials directly in the dumpsters.

We would like to thank the Bren Student Sustainability Committee and Harvard University's EH and S, who shared their procedures with us and helped us to create ours. We would also like to thank Associated Students Recycling, UCSB Environmental Health and Safety, and UCSB Physical Facilities for their critical and insightful feedback.

Jargon:

Berthas: The tan outdoor recycling clusters serviced by the Associated Students Recycling Route/Bicycle Riders.

Building Occupant: Anyone who is participating in an activity in the building. This could be someone coming to the building occasionally, such as for an event or someone who regularly works on the premises. This does not include people passing by the building.

Contamination: This is any material in a bin that does not match the requested material. (Trash in the office paper bin, plastics in the newspaper bin etc..)

Diversion Rate: This is the percent of your total waste stream that is being reused, composted, or recycled rather than landfilled. Materials contaminating the waste stream (aka plastics in the office paper bin are not counted as part of your diversion rate.) The exception to this is when the material in your "trash" is being separated at the MarBorg facility. In this case, the diversion rate for that part of the waste stream would need to be calculated at the sorting facility and then calculated into your overall diversion rate.

E-Waste: Any items that run off of an electrical cord or batteries, tapes, DVDs, CDs, cell phones, Ink cartridges, toner, and batteries. CFLs are universal waste but usually not

accepted in AS Recycling's techno-trash bins. CFLs must be taken to EHS for proper disposal.

Hard Plastics: (Synonym: Plastics 1-7) Any items that are 100% plastic and hard. Styrofoam is not included as it can only be recycled in very few places in the country, none of which are close to Santa Barbara.

Mini-Trash Bins: This is a new program in Ellison Hall where occupants are giving up their office trash can and its being replaced by a miniature 8in tall trash can. Some other buildings on campus may have different versions of this and those may have different rules associated with them.

Office Pack (Synonym: Office Paper):

Acceptable Papers

- White ledger (bond, typing, copier, index cards, etc.)
- Colored ledger
- Envelopes (colored or white with or without windows)
- Fax paper
- Carbonless paper
- Pamphlets & brochures (but not magazines), stapled but NOT glued
- Manila and bleached file folders
- Catalogs
- Direct Mailings (opened & sorted for contaminants)

Unacceptable Papers

- Magazines
- Newspapers (or inserts)
- Unbleached paper
- Florescent Paper
- Glossy Paper

Don't worry! No need to spend time removing these from your recyclable paper:

- Paper clips
- Plastic tabs
- Metal fasteners
- Wire spirals
- Rubber bands
- Plastic spirals
- Staples
- Press apply labels
- Tape
- White paper ream wrappers
- Pressure sensitive notes

Plastics 1-7 (Synonym: Hard Plastics): Roughly, any items that are 100% plastic and hard. The exceptions in this group are Styrofoam which says #6 on it and Thin/Film Plastics (aka Plastic Bags, "soft" plastics). Styrofoam is only recyclable in a few places in the country, none of which are near Santa Barbara and Thin Plastics must be separated and recycled differently from other Plastics 1-7. Non-Styrofoam plastics #6 are recyclable.

Restroom Waste: Any waste collected in the restroom trash cans. This is considered a biological hazard and cannot be sorted by volunteers or composted in a cold system. This does not include wastewater/toilet waste.

Short Fiber (Synonym: Super Media): Any paper that looks like paper but does not go into office pack (see above) and in general low quality paper. This includes magazines,

glossy papers, newspaper, fluorescents, textbooks and other books. Short fiber refers to the fact that these low quality papers are made up of shorter paper fibers. Shredded paper for instance can't be used to make new office paper since the fibers have been cut short in the shredding process.

Super Media (Synonym: Short Fiber): This means exactly the same thing as short fiber.

Thin/Film Plastics: Any plastic that you can wrap around your hand, the most obvious one being plastic bags. Cellophane, plastic transparencies, etc… are all included.

Senior (Sr.) Lead (Sometimes referred to as Zone Leads): The Custodial Manager assigned to your area of campus

Overview of Timeline:

- Month to two months before:
  - Meet with your group to choose specific dates and go over plan for waste audit.
  - Find funding to award volunteers with pizza.
  - Locate a storage and sorting space (don't have to be the same). See notes below on this.
  - Meet with/call Environmental Health and Safety to go over safety protocols and to set up a safety training for your volunteers.
- Two weeks prior to collection:
  - Host safety training for all volunteers led by Environmental Health and Safety. Go over protocol in this document during the same training.
    - All volunteers must attend this training so make sure to schedule it a time everyone can make it.
- One- Two week(s) prior to collection:
  - Email Superintendent of Custodial Services, Byron Sandoval to give him a heads up and to get an ok on the audit dates and procedure.
  - Email AS Recycling, Ryan Kintz, and the Campus Recycling Coordinator, Mary Ann Hopkins.
  - Ask the Campus Recycling Coordinator, Mary Ann Hopkins to ask MarBorg not to do pick-ups on the dumpster that you are collecting from until after the collection period is complete.
  - Recruit Volunteers.
  - Be careful to tell as few people as possible about the waste audit.
- Day before:
  - Send a reminder email to all the custodial and recycling staff involved. Also send a reminder to EH&S.
  - Ensure that trash is emptied from all rooms the day before the audit.
  - Ensure that the trash and office pack dumpster is emptied the day prior to the collection period and that the dumpster will not be emptied until the collection period is over. Alternatively, you can have volunteers collect the material from the dumpster before the scheduled pick-up time for MarBorg on all days of the collection period.

- Week of audit:
    - Custodians will act "as normal" with the exception of the fact that ALL trash and office paper must be emptied on Tuesday.
    - Send a reminder email to volunteers about dress code/safety, confirm with volunteers.
    - Collect sorting materials (Buckets, gloves, bags, etc).
- Last day of collecting waste:
    - Custodians resume regular collection.
- No more than a few days after the end of audit, sort and weigh all collected types of recycling and trash. The longer a time after the completion of the audit, the smellier the waste will be and the more problems you will have in terms of attracting pests to your storage location.
    - Day of sorting (after collection is complete), send reminder email to volunteers about dress code/safety, confirm with volunteers

Before the waste audit:

1. Email Byron Sandoval (Superintendent, Custodial Services) to give him a heads up about the waste audit and to talk through the process, in particular, focus on anything different that the custodians will have to do. If this is your first time doing this, a few weeks lead time is ideal, if you are a regular sorter and have a relationship with your custodians already a week lead time is enough.

2. If you are going to be including an outside recycling cluster (aka Bertha) or AS Recycling Techno Trash in your building waste audit, contact AS Recycling, ryank@as.ucsb.edu no less than one week prior. Be careful about including the Bertha data since this will also include traffic walking by the building rather than just building occupant behavior. You may however want to include Bertha data when your building has a Bertha located somewhere, such as a courtyard, where there is little traffic from non-building occupants.

3. Always give a heads up to Mary Ann Hopkins, the Campus Recycling Coordinator (preferably one week prior)

4. Customize the data sheet to fit your building and the information you are interested in collecting. The data sheet will change for every building.

5. Find a storage and sorting location (don't have to be the same). It'll get smelly and there may be some leakage from the bags so plan accordingly. You also want a space that building occupants won't go into during the collection and sorting period. Use plastic covering across the whole floor and taped off areas to clearly indicate where each bag came from (Trash, Blue Bins, Bertha, etc). We also recommend having a system to label the bags as a back-up. (See item #1 of "During the Collection Period".)
    - By using only a two-day sorting period rather than a whole week, you can help to reduce encouraging unwanted pests to enter the building. Another option is to rent a truck to use as a storage facility and get permission to

park the truck behind the building. If you only choose to perform the audit for 2 days, make sure to include a Wed and a Tu or Th. in your audit. Mon. and Fri there is decreased attendance and so its harder to get a good sampling. Wed class schedules are so different from Tu/Th that it's important to get data from both types of days.

- In some cases, especially for lab buildings you may choose to audit directly out of the dumpsters

6. Recruit volunteers to help with the waste audit. It helps to recruit folks from other buildings and groups on the campus so you can keep the waste audit secret to anyone in the building. Waste audits are not the most glamorous task, so recruiting early will help ensure you get the people you need.

7. Scrounge up some money to buy pizza for your volunteers

8. Send a reminder email one day before the waste audit is supposed to start to everyone involved to remind them (Byron, MaryAnn Hopkins, AS Recycling). <u>Do not tell anyone who doesn't have to know that the audit will occur. If you tell building occupants about the audit, they are likely to change their behavior which would compromise the data.</u>

<u>During the Collection Period:</u>

1. During this collection period the custodians should be taking out the trash and the trash only. Its easiest to ask them not to take out the Office Pack/Paper which they normally would take out. Have the custodians bring all of the trash bags (unmarked) to the storage room. Have the volunteers service all other bins in the building (including the Office Pack/Paper, Sharps boxes, and recycling) and mark with tape where the bins came from (aka office paper bin, plastic bottle bin, etc) and what the material should be (aka: trash, paper, recycling). When you get to the sorting stage this is valuable because the "unmarked" bags will all be trash and everything else is clearly labeled.
    a. Volunteers will need to empty all of the bins they are in charge of on the last day of the collection period and should have information on-hand about what the waste audit is and potentially a letter from EH&S supporting the audit. Researchers may be concerned as to why their trash is being emptied by student volunteers and where the waste will be going. Information cannot be sent out ahead of time due to not wanting to change occupant behavior.

2. Sharps boxes should be closed up according to standard safety regulations and will be weighed during the audit, but not sorted.

3. Do not tell anyone who doesn't have to know that the audit will occur.

4. Send a reminder email to volunteers that they must wear closed toed (preferably hard toed) shoes, long durable pants, and clothes that can get dirty to the audit. Dust masks, goggles, latex gloves, leather gloves, and smocks or aprons will be given to volunteers on site (if volunteers have any of the above items from lab courses or research, we encourage volunteers to bring their own).

5. Go over your protocols for the actual sorting with your organizing group (whoever is directing volunteers that day) and ensure that you are comfortable with exactly how it will work on site. (This is when you remember all the important details you forgot). Also make sure someone has been designated to direct/train the volunteers that show up.

6. Check on stored bags for stink, leakage, pests, etc…

7. Last day of audit collect any material that custodians wouldn't normally take out (individual recycling bins in offices for example). Also make sure all trash is emptied on this day.

8. Material from the dumpsters should be collected on the final day of the audit and marked "trash dumpster" on the bag.

9. Collect Materials/Tools:
    a. Buckets and/or Light Weight Recycling Bins (These make sorting and keeping track of what is what a lot easier), I recommend at least 10, these can be borrowed from AS Recycling.
    b. Scales: 1-2 Restroom scale(s) works wonders. Its nice to have a scale that calculates lighter weights as well for things like compost (Ellison Hall has a compost scale that can be borrowed).
    c. Extra Bags: 15-20
    d. Latex or similar gloves
    e. Leather or other gloves designed to allow you to hold sharp items
    f. Dust masks
    g. Protective lab glasses/goggles
    h. Aprons/Smocks
    i. Plastic drop cloths to work on
    j. Clipboards and pens
    k. Your customized datasheet
    l. Camera
    m. Clean-up materials: Sponges, mop, towels, surface cleaning spray, etc…

<u>Day of Sorting:</u>

10. Send a reminder email to volunteers that they must wear closed toed (preferably hard toed) shoes, long durable pants, and clothes that can get dirty to the audit.

Dust masks, goggles, latex gloves, leather gloves, and smocks or aprons will be given to volunteers on site (if volunteers have any of the above items from lab courses or research, we encourage volunteers to bring their own).

The Audit itself:

General safety/confidentiality:
Be sensitive about the confidentiality of the material you find in the trash. The people who discarded this refuse did not give you their informed consent to gawk at it, read private mail etc. It is illegal to gather information from someone's trash can.

Safely carry waste-containing bags using proper lifting techniques as to prevent back injuries or punctures from materials inside the bag.

If any material appears to be dangerous, infectious, or otherwise harmful, ask a staff member supervising the waste audit for support before dealing with the material.

Sharps boxes will be closed up according to standard safety regulations and weighed, but not sorted. Sharps and broken glass that are not in a sharps box should be collected by someone wearing leather gloves and weighed.

Autoclave bags, bags which are autoclaved to kill any potential biological hazards, should be weighed, but not opened. Be aware that these may leak and should be treated with caution. Autoclave bags are typically red, but not always, and will have a biohazardous waste sign on the outside of the bag, which should be melted

Volunteers must be turned away if they show up for any of their volunteer tasks without closed toed shoes and long durable pants. Gloves , masks, and goggles are mandatory during the sorting process and must be provided by the volunteer coordinator, though volunteers are encouraged to bring their own.

Setting up the sort:

The trash and recycling bags should already be sorted by where the waste came from (Trash, Blue Bin, dumpster) via location. Everything without a label should be trash and everything with a label will say where it came from.

Workspace: I recommend using a table top if available but any flat surface will work. Cover it with plastic drop clothes or trash bags and tape it down on the edges before starting.

Buckets/containers: Create a bucket for each thing you are sorting (the columns in the data sheet below). Label the bucket with tape on the outside and use a liner/trash bag.

Steps:

1. Take one of the bags of the material you are sorting and spread it on the table/surface. (I recommend doing all the trash bags first, then all the waste from the blue bins, etc…)
2. Divide it into buckets/containers by type of material. It's easiest if you assign each person to one or two types of materials and have them pick out all of that material.
3. Once the volunteers sorting start filling up buckets/bags, you can have a second set of volunteers start the weighing process.
4. To weigh you can do two things. Tare the bucket and then weigh the material in the bucket or tare a person and then have the person hold the bag of material from the bucket. The later is sometimes easier when working with a restroom scale.
5. Record the weights on your data sheet (see below for an example) or on a whiteboard if available. Have one designated person taking data. Make sure to include the weight of the bag in the data.

EXAMPLE **Data Sheet (you will need to customize this for your own audit):**

	All weights in Lbs.	Materials																
		Trash	Bio Haz bags (do not open only weigh)	Paper Towels/ Tissues	Office Paper (Pack)	Super Media/ Short Fibers	Com-post	E-waste (Equipment only)	E-waste (non-equip-ment)	Thin Plastics	Plastics 1-7/ Hard Plastics	Alumi-num	Other Metals	Glass (non-Pyrex)	Glass (Pyrex)	Sharps/ Broken Glass	Pack-ing Pea-nuts	Styr foa (not nut
Recycling and Trash Bins	Trash Dumpster																	
	Trash																	
	Office Paper Dumpster																	
	Office Paper (Pack)																	
	Techno-Trash Cluster																	
	Lab-run recycling programs																	
	<insert name of lab and designation of bin here>																	
	Bertha- Plastic 1-7/Aluminum (#53)																	
	Bertha-Glass																	
	Bertha- Newspa-per																	
	Bertha- Trash																	
	Furniture/ Equipment (left by bins)																	
	Sharps Boxes (Don't sort)																	
	Restroom Waste (Don't sort)																	

Please pay more attention to the basic design of this data sheet, rather than the specific columns or rows. Things to note:

a. The rows indicate bins that you have in your building. If you only have a trash bin, an office paper recycling bin, and a E-waste bin in your building you would only have 3 rows.

b. The columns are types of material. Once you sort/audit the bags of materials that come in from the bins, you will get weights for what was in each bin. For instance in the Office Pack/Paper row you should have mostly office paper, any other columns that are filled out would be considered “contaminants”.

c. I greyed out all but one column in the “Restroom waste” and “Sharps” row since we will not sort any further due to safety concerns.
d. I included the closest Bertha on the data collection sheet, but if your closest bertha gets a lot of “walk-by” traffic, you can’t include these weights in your diversion numbers.
e. I also included the dumpster waste. This data is similar to the bertha data, in that you need to consider how many other buildings are using this dumpster in order to make assumptions about how that affects your diversion rate. Labs are unique in that many labs bring their waste directly to the dumpster, and so not looking at this stream at all, you would miss a lot.

<u>How specific should you be?</u> You should consider the following:

- What do other buildings on campus measure in their audits?
- What will I use this data for? (Granting agencies for instance might be interested in a certain part of the waste stream)
- What data would be useful for behavioral change? (# of coffee cups)
- Minimum separation for UCSB (based on the most significant weights in the waste stream and past waste audits. This “minimum” data collection for waste audits will allow us to compare between buildings):
    - Plastic (1-7), Aluminum, Glass
    - Cardboard
    - Office Paper
    - Compost
    - Newspaper

<u>Crunching the Data:</u>

Diversion Rate =
((All properly sorted recyclables) + (All properly sorted compost)) ÷ (Total waste stream)

**Remember no cherry picking, if you have a program that collects recyclables from other buildings on campus, you can only count this towards your waste stream if you also are counting the trash from those buildings as well.*
**ONLY include berthas in your diversion rate if there is no “walk-by” traffic (for instance the Bren courtyard has a Bertha that only building occupants use so that is a legitimate cluster to include in the Bren Diversion rate)*
**dumpster data is similar to the bertha data, in that you need to consider how many buildings use this dumpster.*
**For consistency, do not include re-use programs in the waste diversion rate for a single building. Most buildings do not capture this data in their waste audits.*

Contamination Rate of recycling =
(All improperly sorted recyclables) ÷ (total materials in recycling bins (proper and improper))

**Its often helpful to calculate contamination rates for each of your material streams (aka "There was 10% contamination in the office paper and 5% contamination in the plastics. Overall there was 15% contamination in the recycling stream")

Lab recycling tips:

1. All plastics 1-7 are recyclable in SB County and a large enough percentage of lab plastics are in the category of 1-7, that you may assume that it is a 1-7 plastic if it doesn't have a number on it.

2. Plastics do not need to be marked with a number in order to be recycled. When it gets to the recycling sorting station at MarBorg, the local waste hauler, the sorters will make their best guess as to which type of plastic it is. If they cannot make a reasonable guess as to which number it is, they will landfill it. Remember though, they look at these materials every day and so are really good at guessing.

3. Pyrex glass is not recyclable. One reason for this is that Pyrex is designed not to melt at the temperatures that glass recyclers use to melt glass in the recycling process.

4. Sharps boxes are for broken glass and needles. Glass which is neither Pyrex, nor broken, may be recycled.

5. If it can go into a standard trash can, it can go into a recycling bin (in terms of safety, contamination, and hazardous materials). If you are worried about it going into a recycling bin due to the fact that people will be handling the waste, you should not be putting it in a trash can. The exception to this rule is empty chemical containers. These cannot be recycled.

6. Aluminum Foil is recyclable. This is a low value recyclable, however MarBorg encourages you to recycle it.

7. Styrofoam packing peanuts and any packing materials small enough for you to use them in most size mailing boxes can be reused by returning them to mail services or asking the mail delivery person to pick them up from your departmental mail room. Formed styrofoam blocks are not recyclable and will not be reused by mail services.

8. Batteries, CDs, DVDs, anything with an electrical cord, VHS tapes, cassette tapes, anything that runs on batteries, copier toner, ink jet cartridges, and fluorescent light bulbs are all considered electronic or universal waste. Most of these are **illegal** to send to a landfill and must be recycled or taken to a hazardous waste facility. The CDs, DVDs, and VHS and Cassette Tapes, copier toner, and

ink just cartridges are the only ones in the list above that are not illegal to throw away in a trash can.

9. Thin plastics, defined as any soft plastic that you can wrap around your hand can be recycled if grouped together and taken to a proper receptacle. They cannot be recycled in most Plastics 1-7/Hard plastics bins. This does include cellophane, plastic wrap, plastic bags of all sorts, and transparencies (to name a few).

		Materials																
		Trash	Bio Haz bags (do not open only weigh)	Paper Towels/ Tissues	Office Paper (Pack)	Super Media/ Short Fibers	Compost	E-waste (Equipment only)	E-waste (non-equipment)	Thin Plastics	Plastics 1-7	Aluminum	Other Metals	Glass (non-Pyrex)	Glass (Pyrex)	Packing Peanuts	Styrofoam (not peanuts)	Cardboard
Recycling and Trash Bins	Trash Dumpster																	
	Trash (taken directly from bins in the building)																	
	Office Paper (Pack) Dumpster																	
	Office Paper (Pack)																	
	Techno-Trash Cluster																	
	Lab-run recycling programs																	
	<insert name of lab and designation of bin here>																	
	<insert name of lab and designation of bin here>																	
	<insert name of lab and designation of bin here>																	
	Bertha- Plastic 1-7/Aluminum (#53 on cluster map)																	
	Bertha-Glass (#53 on cluster map)																	
	Bertha- Newspaper (#53 on cluster map)																	
	Bertha- Trash (#53 on cluster map)																	
	Furniture/Equipment that doesn't go in E-waste																	
	Bathroom Waste (Don't sort, only total weight)																	

Centers for Disease Control and Prevention (CDC)
Office of Safety, Health & Environment

LABORATORY RECYCLING PROGRAM STANDARD OPERATING PROCEDURE (SOP)

This LABORATORY RECYCLING PROGRAM STANDARD OPERATING PROCEDURE will become effective for the laboratories at:

Campus	
Building	
Floor	
Laboratory Points of Contact (print names)	
Approval date (start date)	

LABORATORY RECYCLING PROGRAM
STANDARD OPERATING PROCEDURE (SOP)

1. PURPOSE: This SOP outlines the procedures that are followed for the designated CDC laboratories involved in lab recycling. These procedures pertain to laboratories that are categorized as BSL1 or BSL2. Only authorized laboratories are eligible to participate in the lab recycling program.

2. SAFETY PRECAUTIONS: Ensure that only OSHE-approved plastic is collected in the appropriately labeled recycling bins and autoclaved as RECYCLABLE. Follow policy guidance as listed in OSHE Laboratory Waste Disposal.

3. DEFINITIONS:
Autoclave-Required Material: Recyclable laboratory material generated from within the laboratory that has or potentially has come in direct contact with biohazardous materials
Recyclable Laboratory Material: Only plastic laboratory materials numbered 1-6 are recycled as part of the recycling program.

4. PROCEDURES:

A. Autoclave-Required Laboratory Materials Recycling Procedures:

i. Approved recyclable lab materials are collected and contained in a designated bin, in the laboratory, that is lined with two biohazard bags. The designated recycle bin is clearly marked 'CDC' along with a recycling symbol.

ii. When filled, the bagged materials are removed from the recycling bin and the laboratory staff attaches the sticker (provided by Environmental Protection Section of OSHE) "ATTENTION! RECYLCLED Lab Materials" (See Attachment 1).

- The standard autoclaving preparation of adding a sticker with the building and room number of origin along with adding autoclave tape on the outside of each bag is followed.
- The standard autoclaving preparation of adding the appropriate amount of liquid (up to 500 ml for a full load) is followed.

iii. Laboratory staff handles recycled lab material bags in the same manner as other infectious waste.

iv. After being autoclaved, Scientific Resources staff places the decontaminated bags in a designated blue recycle bin located in the autoclave room. (This bin is marked with the CDC logo along with a recycling symbol.)

v. OSHE contractor:

- places the autoclaved recyclable items in a transport recycle bin;
- removes the autoclaved bags for proper disposal;
- takes the autoclaved recyclable items to the recycling area for pickup.

5. RESPONSIBILITIES:

A. Laboratory Staff shall:

i. Segregate approved plastic materials used within the lab and place these into a separate waste bin.
ii. Identify and label biohazard bags used in the collection of approved-recyclable lab materials. (See Attachment 1)
iii. Place all labeled bags in the autoclave room for decontamination by Scientific Resources staff.
iv. Post a metrics sheet in the autoclave room and record the number of bags and estimated weight as provided in Attachment 2.
v. Provide metrics to OSHE POC Kathy Slawson (404-639-4103; fme3@cdc.gov) on a monthly basis. (See Attachment 2)
vi. Sign a Statement of Understanding (See Attachment 3) indicating willingness to comply with this SOP as written, and knowing who to contact for further information.

B. Division of Scientific Resources shall:

i. Autoclave all properly labeled bags for proper decontamination of the materials.
ii. Remove bags labeled 'ATTENTION! RECYCLED Lab Materials' from autoclaves and place them in the marked designated blue recycle bins within the autoclave room.
iii. Provide a separate and labeled receptacle on the clean side of the autoclave room to contain the slit autoclaved bags generated by the OSHE Contractors.

C. OSHE Contractors shall:

i. Remove the autoclaved bags from the designated recycle bin within the designated autoclave rooms.
ii. Transfer the autoclaved recyclable items to the transport recycle bin located **outside of the autoclave room**,
iii. Transport the clean recyclables to the general collection area for pickup.

6. POINTS OF CONTACT for Laboratory Materials Recycling Program

Laboratory:

Sandy Martin	404-639-1325, zho4@cdc.gov
Sandy Steiner	404-639-2473; sxs8@cdc.gov

Division of Scientific Resources:

Curtis Taylor	404-639-2402; clt4@cdc.gov

Office of Safety, Health, and Environment:

Kathy Slawson	404-639-4103; fme3@cdc.gov
Willie Potter	404-639-3317; wcp2@cdc.gov

Attachment #1

Example of our Recycling Sticker, which is placed on Biohazard Bags containing recyclable materials.

ATTENTION!

RECYCLED

Lab Materials

Attachment #2

Use this log to report recyclable laboratory material leaving your area.
Send these monthly metrics to Kathy Slawson at fme3@cdc.gov

Log Record for Lab Recycling Program

Date	# of bags	Level of bin upon collection Full =75 pounds	3/4 full = 56 pounds	1/2 full = 38 pounds	1/4 full = 19 pounds	Estimated Weight recycled on this date

LABORATORY RECYCLING PROGRAM
STANDARD OPERATING PROCEDURE (SOP)

Attachment #3

All Laboratory Staff participating in the recycling program are required to sign this Statement of Understanding below, acknowledging understanding of the information presented in the attached SOP, and knowing who to ask for further information or assistance.

Statement of Understanding

In signing below, I acknowledge that I have read the SOP, and I understand the information presented and/or know who to ask if I need more information or assistance.

Document Name: Laboratory Recycling Program – Standard Operating Procedure		
Any questions about this document can be directed to: Sandy Martin at 404-639-1325; Sandy Steiner at 404-639-2473; Kathy Slawson at 404-639-4103.		
Name (Print)	**Signature**	**Date**

LABORATORY RECYCLING PROGRAM
STANDARD OPERATING PROCEDURE (SOP)

Accepted and agreed:

Job title	Print name	Signature	Date
Lab Chief / Supervisor			
Laboratory Safety Representative			
Chief, Laboratory Support Branch	Curtis Taylor		
CDC Biosafety Officer (Acting)	Bill Howard		
Director, Office of Safety, Health, and Environment	Paul Meechan		

Green Lab Certification

Thank you for joining the **UC Davis Green Labs** campaign! We want to empower you to bring significant resource conservation to your lab, and we need your help. When done well it will also enhance your research with shared equipment, analytical techniques, sample management, and eventually free chemicals and equipment.

This Standard Operating Procedure checklist is for your research group to follow over a few or several months, your choice – a straightforward module-a-month plan will complete your certification in 10 months. We spread out the time so your assessment will be thorough and so you could share results and questions with your peers. Of course, feel free to complete in a shorter time period if you are motivated to do so!

This Checklist brings workplace conservation to research laboratories, and most importantly, your laboratory. Not all the items will apply to your lab, so they won't be counted against the total score. There may also be additional issues for your lab, and you are invited to send in ways you can save energy, toxic substances, green house gas emissions, landfill impact, oh yes, and money!

Instructions

1) Nominate one member of your group to be the **Eco-Leader**. They usually are highly motivated to Be Green. Our goal is to enroll different people in your group for each module, allowing for multiple people to be able to assess opportunities for conservation and pursue them, thus deepening the knowledge base and habits of your group. It also divides up the work among team members and gives you *easy points* ! The leader for an individual module is called the **Module Leader**.
2) Decide on a timeline with your group and go through one check list page per month (or dare to complete more than one a month!). Print out that page and post it in your lab.
3) It is the **Module Leader**'s job to investigate each item in depth and **1)** determine if it applies to your lab, **2)** determine if your lab already follows this practice, and **3)** get your lab to follow the practice if not.
4) At the end of the month explain that month's checklist and report to your group on the achievements for that checklist and enter the appropriate scoring on line. Discuss each item on the checklist with your group even if it does not apply because it may be important in another setting.
5) Questions may be directed to labwikiucdavis@gmail.com or apdoyle@ucdavis.edu.
6) Suggestions for additional practices may be made to labwikiucdavis@gmail.com. Submit extra suggestions to gain bonus innovation points.
7) At a lab meeting at the end of the month, the **Eco-Leader** goes through the check list page with the research group to make sure each member understands it. (Easy Points!)
8) For each topic that your lab practices currently (and for most of the previous year, if repeating the checklist), your group scores the appropriate points. Sometimes there is a sliding scale, so be honest about how well you fulfilled the task.
9) Score each practice. If it does not apply, select **n/a** from the pull-down list. Leave it at **0** only if you're not addressing this practice and it does apply.
10) The **Module Leader** can eliminate points that do not apply to your research group.
11) Add up the potential points and the scored points and then send them to the UC Davis Green Labs website, labwikiucdavis@gmail.com
12) Staff or interns at Green Labs will update the scores from your building/department and check in on progress.

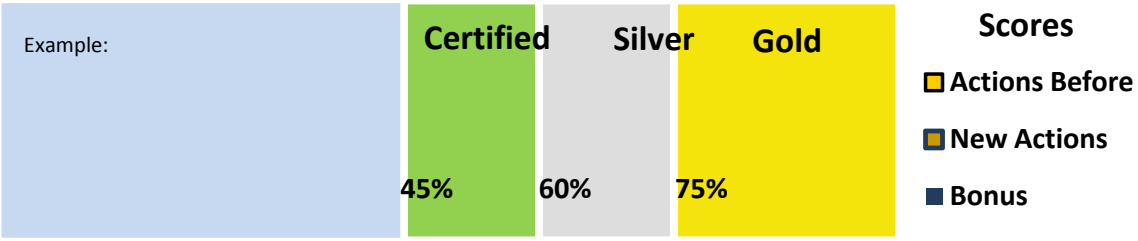
Thank you for stepping forward for such an important issue, to bring resource conservation to your workplace!

PI: **Dr. German** **Date:** **2011**

Eco-Leader: **Lan**

note: points not actual in this modelled sheet

Building: **RMI SOUTH** **Department:**



10 Modules Complete				Doing Previous	Doing Now	Bonus Points	Possible Score
	Module	Module Leader	Mark "x" if Done	**0**	**0**	**0**	**0**
1	**Energy I**	Kenneth	X	0	0	0	24
2	**Energy II**	Eva	X	0	0	0	44
3	**Water**	Dave	X	0	0	0	18
4	**Solid Waste I**	Nancy Rivera	X	0	0	0	13
5	**Solid Waste II**	Bill	X	0	0	0	9
6	**Electronics**	Laura	X	0	0	0	14
7	**Green Chemistry**	Mickael	X	0	0	0	14
8	**Communication**	Matthew	X	0	0	0	20
9	**Travel**	Bonnie Dixson	X	0	0	0	9
10	**Field Work**	Laura	X	0	0	0	10

#DIV/0! #DIV/0!

Green Labs Assessment Tool

PI: Bruce J German

Date: May 11th **2012**

Eco-Leader: Lan

Module Leader: Kenneth

Building, Room#:

Achieved Points		Eligible Points		
0	0	24	As your score increases, the color will slowly change to green	0%

Before GreenLa	After GreenLa	Eligible Points	Energy: Plug Load & Lighting	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader for lab		
N/A	N/A	1	Bonus Points: Assigned Module Leader for Energy I is different than Eco-Leader		
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	2	Remove space heaters, replace with radiant panel heaters or wear a sweater!		
0	0	2	Turn off chilled centrifuges, ovens and GC's when not in use and make a durable, attractive sign.		
0	0	1	Check for energy-saving modes on all pieces of equipment. If it has a built-in timer or low-power mode, use it!		
0	0	1	Choose the right size appliance. If you need one often, others may too.		
0	0	2	When in doubt, measure the power consumption. Ask for a power measurement!		
0	0	2	Report measured power use and log it on Labs21 WiKi, including performance. [13]		
0	0	2	Make sure all computer monitors go into power-saving mode. No screen-savers!		
0	0	1	Set all computers to sleep or hibernate at night, or turn off manually every time you leave the lab. (1 pt for each computer)		
0	0	2	Learn how to use the lab's light switches, and use multiple light levels appropriately.		
0	0	2	Turn off overhead lights if daylight is adequate.		
0	0	3	Identify overhead fluorescent lamps that may be removed and coordinate with building manager.[14]		
0	0	2	Use a task light if working alone in the lab or office. Clip-on or permanent under-shelf are great.		
0	0	2	Leave hall lights off if standby lights are adequate or arrange with building manager to reduce them		
0	0	2	Make sure lights are always turned off in sporadically used rooms: storage rooms, cold rooms, microscopy rooms, etc. Add an occupancy sensor if you can.		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: **2012**

Eco-Leader: Lan

Module Leader: Eva

Building, Room#:

Achieved Points		Eligible Points		
0	0	44	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Energy: Cold Storage & HVAC	Initial Here	Date When Completed
N/A	N/A	1	Bonus points: Assign Eco-Leader for lab	LG	3/2/2011
N/A	N/A	1	Bonus points: Assigned Module Leader for Energy II is different than Eco-Leader	ET	4/27/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	2	Do not use incubators as refrigerators. Easy points!		
0	0	2	Defrost inside and vacuum outside on refrigerators & freezers coils annually or biannually.		
0	0	2	Ask for Energy Star appliances and instrumentation when purchasing. Push your sales rep!		
0	0	2	Recycle old freezers and buy Energy Star™		
0	0	3	Eliminate old and worthless samples in your standing and walk-in freezers.		
0	0	4	If an environmental room or incubator is unused, turn it off (after checking with others).		
0	0	3	Create a spreadsheet or inventory of valuable frozen samples.		
0	0	4	Consolidate your ultra cold samples with a colleague and retire the freezer for a SUBSTANTIAL rebate.		
0	0	3	Archive frozen samples at room temperature (as many as feasible, sliding scale)		
0	0	1	Use appropriate size containers for ice, dry ice, and liquid nitrogen		
0	0	4	Nominate a "Cold Storage Coordinator" for your research group [22]		
0	0	4	Find out if your space has a 2-degree or 6-degree temperature band. Work with facilities to widen the band if your research allows it.		
0	0	4	Close Fume Hood sashes - ALWAYS		
0	0	2	Use heating and cooling systems correctly: don't block thermostats, don't put too many hot appliances in one lab.		
0	0	3	Work with your Energy Manager to identify hot and cold spots on your floor. Why are they that way?		
0	0	1	Lab doors kept closed to allow for room ventilation to run as designed.		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: **2012**

Eco-Leader: Lan

Module Leader: Dave

Building, Room#:

Achieved Points		Eligible Points		
0	0	18	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Water	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader		
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader		
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	1	Eliminate vacuum aspirators		
0	0	2	Reduce single pass cooling		
0	0	2	Check the efficiency of DI/RO/Purified water systems. All create waste water as well as purified water, with varying ratios. Recognize that you are using more water than you put in your beaker.		
0	0	1	Look for water-saving modes on any piece of water-using equipment.		
0	0	2	Use timers for water valves set to minimum necessary time		
0	0	2	Limit flow through lab faucets with aerators or water misers.		
0	0	2	Use the appropriate quality water for each task		
0	0	2	Wash labware efficiently		
0	0	1	Be efficient with: Ice Makers, Autoclaves, and Stills		
0	0	2	Eliminate water stills if adequate quality water can be obtained by DI or RO.		
0	0	1	Look for and report leaks at icemaker and autoclave drains.		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: **2012**

Eco-Leader: Lan

Module Leader: Nancy Rivera

Building, Room#:

Achieved Points		Eligible Points		
0	0	13	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	**Solid Waste I**	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader	NR	10/26/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	2	Re-use disposable plastic and glass items	NR	11/23/2011
0	0	2	Set up recycling bins for plastic, glass, and metal		
0	0	1	Buy chlorine free paper; recycle and reuse paper		
0	0	2	No page left blank: Collect clean one-sided paper and use it; "GOOS paper" station well used		
0	0	2	Evaluate Red Bag waste practices, if applicable. Ensure that Red Bag waste is separated from regular waste (which can go straight into the landfill).		
0	0	2	Identify 3-5 biggest, heaviest or most valuable waste streams from your operation.		
0	0	2	Divert one of your top 3 waste streams from the landfill		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: **2012**

Eco-Leader: Lan

Module Leader: Bill

Building, Room#:

Achieved Points		Eligible Points		
0	0	9	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	**Solid Waste II**	Initial Here	Date When Completed
N/A	N/A	1	Bonus Point: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Point: Module Leader different from Eco-Leader	BM	10/26/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	1	Recycle unusable metal equipment and furniture	BM	11/29/2011
0	0	1	If you are constructing apparatus, reuse scrap material	BM	11/29/2011
0	0	1	Contribute materials to your departmental shop (no junk!)		
0	0	1	Put corrugated cardboard in hallway after collapsing		
0	0	1	Collect boxes before you move your lab or home		
0	0	1	Return Styrofoam peanuts to storeroom or shipping store		
0	0	1	Set up a battery collection bin		
0	0	2	Salvage fixtures long before demolition starts		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: May 10th **2012**

Eco-Leader: Lan

Module Leader: Laura

Building, Room #:

Achieved Points		Eligible Points		
0	0	14	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Electronics	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader	LG	4/27/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	1	Try low-tech electronic repairs yourself	LG	5/3/2011
0	0	1	Make easy mechanical repairs and maintenance	LG	5/3/2011
0	0	1	Ask shop staff to fix electronic equipment	LG	5/4/2011
0	0	1	Request repairs or installation of equipment from shop staff	LG	5/9/2011
0	0	2	Equipment on all night? UC Davis has free outlet timers to save you energy!		
0	0	2	Broken Timer? Buy an external one		
0	0	2	Share equipment with colleagues or departmental list serves		
0	0	1	Seek free equipment ON campus		
0	0	1	Seek free equipment OFF campus		
0	0	1	Donate usable items to a departmental "free shelf"		
0	0	1	Dispose of all electronics through an electronic waste recycling program		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: May 10th **2012**

Eco-Leader: Lan

Module Leader: Laura

Building, Room #:

Achieved Points		Eligible Points		
0	0	14	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Electronics	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader	LG	4/27/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	1	Try low-tech electronic repairs yourself	LG	5/3/2011
0	0	1	Make easy mechanical repairs and maintenance	LG	5/3/2011
0	0	1	Ask shop staff to fix electronic equipment	LG	5/4/2011
0	0	1	Request repairs or installation of equipment from shop staff	LG	5/9/2011
0	0	2	Equipment on all night? UC Davis has free outlet timers to save you energy!		
0	0	2	Broken Timer? Buy an external one		
0	0	2	Share equipment with colleagues or departmental list serves		
0	0	1	Seek free equipment ON campus		
0	0	1	Seek free equipment OFF campus		
0	0	1	Donate usable items to a departmental "free shelf"		
0	0	1	Dispose of all electronics through an electronic waste recycling program		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: 2012

Eco-Leader: Lan

Module Leader: Mickael

Building, Room #:

Achieved Points		Eligible Points		
0	0	14	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Green Chemistry	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader	MM	4/27/2011
N/A	N/A	1	Bonus Innovation Points:substitute Acetonitrile with ethanol	DB	10/30/2011
N/A	N/A	1	Bonus Innovation Points:Recycled used ethanol	LG	10/30/2011
0	0	1	Donate surplus chemicals	MM	10/30/2011
0	0	1	Request free chemicals		
0	0	2	Seek ways to minimize chemical use		
0	0	1	Exchange mercury thermometers for spirit thermometers		
0	0	1	Avoid use of unprotected metallic lead		
0	0	1	Washing glassware with minimum solvent rinsing		
0	0	2	Solvent purification: on-site distillation vs. pre-purified canisters		
0	0	2	Avoid halogenated reagents if possible		
0	0	2	Alternate methods to wet chemical spectroscopy		
0	0	1	Post the 12 principles of Green Chemistry in your lab		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: **2012**

Eco-Leader: Lan

Module Leader: Matthew

Building, Room #:

Achieved Points	Eligible Points	
0	0	20

As your score increases, the color will slowly change to green

0%

Before GreenLab	After GreenLab	Eligible Points	Community	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader		4/27/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	2	Inform colleagues of conservation techniques	ML	10/27/2011
0	0	1	Advocate to department and UCD administration		
0	0	1	Advocate for adequate maintenance staff to repair and service items in house	ML	10/27/2011
0	0	1	Pick up the phone instead of emailing	LG	12/15/2011
0	0	1	Clarify management issues in your lab and get training	LG	12/15/2011
0	0	2	Communicate with operations staff	LG	12/15/2011
0	0	2	Start a Conservation committee for your department or building		
0	0	2	Join a departmental network of laboratory contacts		
0	0	2	Find out if you think common use equipment may be turned off		
0	0	2	Take time to explain conservation techniques to colleagues from other countries or cultures		
0	0	1	Make simple requests by email to your department		
0	0	1	Support a departmental list server that offers good communication across departments		
0	0	2	Develop cordial relationships with custodians, ventilation and electrical maintenance staff		
Questions for Sustainability Manager					

Green Labs Assessment Tool

PI: Dr. German

Date: April 27th **2012**

Eco-Leader: Lan

Module Leader: Bonnie Dixson

Building, Room #:

Achieved Points		Eligible Points		
0	0	9	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Transportation	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader	BD	4/27/2011
N/A	N/A	1	Bonus Innovation Points: Drive a hybrid vehicle to work		
N/A	N/A	1	Bonus Innovation Points:		
0	0	2	Regularly carpool, ride your bike or take public transportation (one point for every 20% of staff that take alternative transportation 3 days / week.)		
0	0	2	Take Yolobus to the Airport. (1pt for each staff member that has tried it out).		
0	0	1	Only ship overnight or "rush" when absolutely necessary		
0	0	1	Buy carbon offsets with "additionality"		
0	0	2	Use teleconferencing or videoconference instead of flying to a meeting		
0	0	1	Find alternative transportation around campus (serious and funny).		
Questions for Sustainability Manager					

0
0

Green Labs Assessment Tool

PI: Dr. German

Date: **2012**

Eco-Leader: Lan

Module Leader: Laura

Building, Room #:

Achieved Points		Eligible Points		
0	0	10	As your score increases, the color will slowly change to green	0%

Before GreenLab	After GreenLab	Eligible Points	Field Work	Initial Here	Date When Completed
N/A	N/A	1	Bonus Points: Assign Eco-Leader	LG	3/2/2011
N/A	N/A	1	Bonus Points: Module Leader different from Eco-Leader		4/27/2011
N/A	N/A	1	Bonus Innovation Points:		
N/A	N/A	1	Bonus Innovation Points:		
0	0	1	Use reusable or recyclable staking/flagging material	LF	10/19/2011
0	0	1	Account for and recover all staking/flagging materials deployed in the field	LF	10/19/2011
0	0	1	Use reusable or recyclable sample containers. Autoclave to sterilize if necessary.	LF	10/19/2011
0	0	1	Only use sterile sample containers when necessary.		
0	0	1	Switch from paper to electronic data collection		
0	0	1	Reduce water use by using water-conserving technology (e.g. drip hoses), and watering at appropriate times during the day		
0	0	2	Recover all batteries and electronics deployed		
0	0	2	Reduce travel footprint by: eliminating unnecessary travel, carpooling, purchasing carbon offsets, etc.		
Questions for Sustainability Manager					

Lab name _____

Equip type_____

Your device consumes _____ kWh/day.

Settings/Usage (temp/frequency)

_____

Energy use of this unit compared
to others of the same type:

Low — High

≅ 5kWh/day

2 LCD TVs

≅ 15-30 kWh/day

Electricity

Need help defrosting or cleaning out your lab freezer?

Borrow the CU Green Labs Mobile Freezer

(main campus only)

We will deliver it to you!

-20° C manual defrost freezer

No food, radioactive materials,
or flammable chemicals allowed

To borrow this mobile freezer, please contact:

Ashlyn Norberg at ashlyn.norberg@colorado.edu
301-802-9852

CU Green Labs Contact:
Kathy Ramirez
greenlabs@colorado.edu
303-492-5562
ecenter.colorado.edu/greenlabs

Environmental Health & Safety

Facilities Management Sustainability

University of Colorado Environmental Center

You Can Turn Off Climate Change

Don't be so COLD

unless absolutely necessary

store freezer samples at the temperature they require rather than colder

An ULT (Ultra Low Temperature) freezer uses 10 TIMES the electricity of an Energy Star -20˚ C freezer

ULT freezer

15-30 kWh/day

-20˚C Energy Star

2 kWh/day

The ideal storage temperature of your samples may be warmer than ULT freezer temperatures

Be energy efficient by choosing your freezer and temperature wisely

Freezer Type	Electricity Consumption
ULT	15-30 kWh/day
-40˚C	8-10 kWh/day
Lab grade -20˚C	6-19 kWh/day
Energy Star -20˚C	2 kWh/day

For info on samples that labs are storing at -70˚ C or warmer go to ecenter.colorado.edu/greenlabs

CU Green Labs Contact:
Kathy Ramirez
greenlabs@colorado.edu
303-492-5562

Environmental Health & Safety

FACILITIES MANAGEMENT SUSTAINABILITY

UNIVERSITY OF COLORADO ENVIRONMENTAL CENTER

YOU CAN TURN OFF CLIMATE CHANGE

Give Your Compressor a Break!

Increase the temperature of your ULT(Ultra Low Temperature) Freezer to -70º C

=

2-4 kWh/day saved
same as a LCD TV

Save Energy While Extending Freezer Lifetime

- Increasing the temperature means the compressor does not have to work as hard.
- Since the compressor works less, there is reduced risk for compressor failure.
- 34 ULT freezers at CU-Boulder and 40 at UC-Davis are already at -70° C or warmer.

Join These CU-Boulder Labs That Are Already at -70˚ C

- Anseth
- Blumenthal
- Chen/Junge
- Collins/Stitzel
- Copley
- Ehringer/Marks
- Garcea
- Han
- Martin
- Moore
- Poyton
- Seals
- Schmidt
- Shen
- Smolen
- Stein
- Taatjes
- Winey
- Xue

For info on samples that labs are storing at -70˚ C or warmer go to ecenter.colorado.edu/greenlabs

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Environmental Health & Safety

Facilities Management Sustainability

University of Colorado Environmental Center

You Can Turn Off Climate Change