



## **Minimize Other Environmental Impacts**

### **Reduce Laboratory Air Emissions**

UBC research can impact air quality through accidental release of toxic chemicals, ozone-depleting substances, emissions of volatile organic compounds, and emission of greenhouse gases (primarily CO<sub>2</sub>), or acid rain gases (primarily NO<sub>x</sub>). For more information on air contaminants, also refer to Environment Canada's Criteria Air Contaminants and Related Pollutants.

Although laboratory emissions are not regulated at this time, it is reasonable to expect that releases to the atmosphere will be controlled. The release of vapours to the atmosphere, via evaporation in a fume hood, for example, is not an acceptable disposal method. Apparatus for operations expected to release vapours should be equipped with appropriate trapping devices.

Fume hoods, the most common source of laboratory releases to the atmosphere, are designed as safety devices to transport vapours away from the laboratory in case of an emergency, not as a routine means for volatile waste disposal. Units containing absorbent filters (chemical scrubbers) have been introduced into some laboratories, but have limited absorbing capacity, and the air from these units cannot be reintroduced into the laboratory.

Simple laboratory practices can minimize air emissions:

- Keep containers of volatile chemicals tightly capped. The best container seals have an even rim on the bottle and an appropriate fitting cap with polyethylene or Teflon liner
- Minimize the number of volatile chemicals in your lab; order and store only what you need in the immediate future
- Do not store chemicals in the fume hood
- Keep laboratory experiments involving volatile chemicals as self-contained as safely possible
- Redirect fume hood vapours to a common trapping device to eliminate discharge into the atmosphere
- Keep waste solvent collection containers capped at all times, unless adding waste
- Keep the amount of waste solvents in your lab to a minimum
- Do not dispose of any chemical by evaporation; it is illegal to evaporate hazardous chemical waste for the purpose of disposal
- Do not dispose of hazardous gases by venting. Scrub or filter experiments' hazardous emissions

### **Ozone-Depleting Substances**

Ozone-depleting substances (ODS) only become a threat to the ozone layer when they escape into the environment. For a list of ODS and the protocol pertaining to environmental release of ODS refer to the UBC Ozone Depleting Substances Procedure.

Relevant information can be found on the RMS Ozone Depleting Substances webpage.



## Energy Saving in the Laboratory

Energy is used in nearly every process performed in the laboratory including heating, cooling (water condensers, water circulators), distillation, running of the equipment, facilitating photochemical and microwave reactions, and more.

A survey of UBC's laboratory energy use was done in 2010 to provide researchers with an understanding of the energy consumption of their current equipment as well as purchasing information to select the most efficient equipment in the future. Refer to the "Carbon Neutral for All?" Laboratory Equipment Energy Efficiency Survey" for details.

Recommendations regarding energy saving measures are listed below:

### General Lab Operations

- Wait until you have a full load before running glassware washers or autoclaves.
- Turn lights off when rooms are not in use and take advantage of natural light where possible.
- Turn equipment off when not in use.
- Keep the lab door and windows shut; it helps keep the building air system in balance.
- Use energy efficient pumping systems.
- Adjust blinds and window coverings on windows that receive direct sun to utilize natural light when possible.
- Electrical devices draw energy 24/7, even when switched off. Plug all radios, cell phone chargers, fans and other personal electronics into a power strip that can be turned off when not in use.

### Chemical Processes

- Know the actual time and temperature needed to run your reactions. Many reactions are run overnight for convenience potentially wasting energy, reagents and water
- Determine the time required for the reaction to go to completion or to get to a maximum yield
- Whenever possible, conduct synthetic methods at ambient temperature and pressure
- Consider using microwave energy to power your reaction. Studies have shown microwave energy to be very efficient, using lower amounts of energy with higher yields
- Changes to process design can reduce energy input requirements (mechanical and thermal)
- Using new solvents, such as supercritical carbon dioxide (TSC=31.1°C), greatly affects the ease of separation, lowering energy input
- Using a catalytic system rather than a stoichiometric process lowers the activation energy required for the reaction

### Refrigeration

- Combine contents of laboratory refrigerators and freezers
- Unplug unused refrigerators or freezers
- Set temperatures as low as necessary for current lab work
  - Set temperature of Ultra Low Temperature (ULT) freezers to -70°C instead of 80°C
- Dust coils on back of refrigerators and clean door seals
- Replace deteriorating door seals
- Defrost units regularly

### Fume hoods

- A typical fume hood uses 3.5 times more energy than an average home
- Operate hoods with sash at proper height for safety
- Close sashes when fume hoods are not in active use



## Water Saving in the Laboratory

Most laboratory buildings use significantly more water per square foot than standard commercial buildings do, primarily to meet their larger cooling and process loads. This greater need also provides laboratories with more opportunities to make cost-effective improvements in water efficiency.

Each of the following conservation tips can have an impact on resource conservation. Many tips cost nothing, only requiring a change in occupant behavior.

### Conserve Water

- Consider reusing water where appropriate in lab processes
- Consider recycling water from some lab machines into appropriate processes
- Establish procedures for sampling, testing and clean-up that minimize the amount of water required. Post these procedures and emphasize compliance

### Faucets

Install more efficient faucets and use:

- Aerators
- Vacuum pumps rather than aspirators
- Pressure-reducing valves
- Automatic sensors

### Washing and Cleaning

- Only run full loads in dishwashers
- Consider replacing an old dishwasher with a new, more efficient model
- Minimize the use of hoses as a cleaning tool; as an alternative, use dry cleaning method (sweep or vacuum clean instead of hosing)
- Establish cleaning procedures that minimize the amount of water required. Post these procedures and emphasize compliance

### Equipment

- Replace old lab equipment with new, more efficient models
- Reduce water use for laboratory equipment
- No domestic water at a flow rate greater than 2 gallons per minute shall be used "once-through" for any laboratory equipment
- Use closed-loop cooling water for equipment cooling instead of open-loop (once-through)
- Use vacuum pumps instead of aspirator fittings on cold-water faucets
- Evaluate the necessity of water heaters and water softeners
- For necessary water heaters and softeners, set backwash frequency to a lower setting
- Turn off ice machines when they are not needed



## **Green Purchasing**

Green purchasing is the selection and acquisition of products and services that most effectively minimize negative environmental impacts over their life cycle of manufacturing, transportation, use and recycling or disposal. Making purchasing decisions that exemplify UBC's commitment to sustainability is made easy with the UBC Sustainable Purchasing Guide ([finance.ubc.ca/procure-pay/sustainable-purchasing-guide](http://finance.ubc.ca/procure-pay/sustainable-purchasing-guide)) and the following BMPs.

Order "Green" to reduce your environmental impact simply by the way you place your laboratory orders.

### **Consolidate orders**

- Combine purchases so that each order is \$500 or more
- Purchase as many lab supplies as possible from one source
  - e.g. buy PCR enzymes, bundle with tubes, pipette tips, bench covers, etc.
- Reduces multiple deliveries and greenhouse gases on campus
- Saves on freight charges and saves time

### **Purchase multiple-item packs instead of singles**

- Reduces waste from packaging materials

### **Increase item lines per order**

- Saves paper and energy
- Reduces multiple shipments

### **Place orders/do transactions online**

- Eliminates paper waste
- Reduces order processing time
- Minimizes ordering mistakes

### **Support institutional supplier consolidation initiatives**

- Avoid multiple shipments from multiple vendors
- Eliminates loss of potentially hazardous materials via common couriers

### **Avoid air shipments where possible**

- Reduces CO<sub>2</sub> emissions
- Avoids expensive freight charges

## **Green Product Labels and Certifications**

An easy way to find greener alternatives is to look for green product labels and certifications when purchasing. These labels are symbols that indicate a product has been certified to a specific environmental standard. Product certification labels can also help consumers to combat "greenwashing".

## **Green Products**

Many companies are now offering "greener" alternatives to their consumable products. Replacing some of the consumables used in your laboratory with their green counterparts is an effective way to reduce the environmental impact of your research.

As the demand for greener laboratory products rises, the variety of environmentally friendly merchandise also grows. The UBC "Green Products List" outlines greener alternatives to traditional laboratory products and equipment and what benefits they provide to the user and environment.



Also refer to VWR “Green Leaf Products” (Environmentally Preferable Products), Sigma Aldrich “Greener Alternatives” (Greener Products and Programs), etc.

### **Purchasing Decisions with Big Energy Impacts**

- Add flow restrictors to lab faucets to minimize water use (especially hot water).
- Replace old, large refrigerator/freezers with smaller, newer refrigerator-only units where appropriate.
- Purchase energy-efficient equipment during lab renovations or when older pieces of equipment stop working. Many lab equipment vendors are starting to install power save modes, efficient motors, and other strategies for reducing energy use of plug load lab equipment. Look for the ENERGY STAR® label and ask your vendor for energy usage information or to supply more sustainable products at a reasonable cost. Here are some pieces of equipment that have readily available energy efficient options:
  - Biosafety cabinets
  - Fume hoods
  - Centrifuges
  - - 80°C Ultra Low Temperature (ULT) Freezers
  - Fridges and freezers
  - Ice machines
  - Heat blocks
  - Incubators
  - Ovens
  - Mixers and shakers
  - Vacuum pumps

### **Resources**

Refer to the UBC Green Labs webpage ([greenlabs.ubc.ca](http://greenlabs.ubc.ca)) Toolkits - Green Purchasing and Green Products List.