The Emory Freezer Challenge

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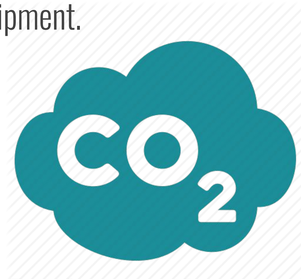
Statement of Problem

Rising CO_2 levels are key contributors to climate change. To combat this problem, our carbon reduction plan seeks to reduce CO_2 emissions resulting from Emory's use of refrigerators/freezers. As a research institution, refrigerators and refrigerants are widely used on campus for scientific purposes. The Emory Freezer Challenge attempts to quantify carbon dioxide emissions and associated costs due to laboratory cold storage equipment.



Background

According to Project Drawdown, refrigerant management is ranked #1 in importance of reducing global CO_2 emissions.[1] The Emory team chose to audit the energy needed to power refrigerators and freezers in Emory's Department of Chemistry as a pilot study for later investigations of refrigerant management. To encourage best practices, the team started the Emory Freezer Challenge.

Co-Benefits of Refrigerator and Freezer Management

Help labs. Help the Earth.

CO2 Calculations

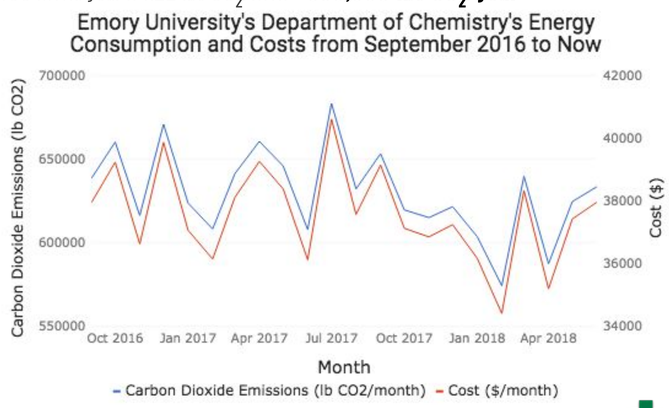
Powering the cold storage equipment comprises 7% of the Department of Chemistry's total carbon emissions and energy costs. The carbon emissions from powering all refrigerators and freezers in the Emory Chemistry department is equivalent to the carbon emitted from **4.7 1995 mid-size sedans throughout their lifetime.**[2]

Energy Consumption from powering all Refrigerators and Freezers:

- Power (W) of all audited equipment = ∑[Voltage (V) x Current (I)] → kWh/day based on 24 hour days = 1300 kWh/day
- (1300 kWh/day x 365 days/year) x (1 MWh/1000 kWh) = **460 MWh/year**

Carbon Emissions from powering all Refrigerators and Freezers:[3]

- 40.0 MWh/month x 1.22 lbs CO_2/kWh = **47,000 lbs CO_2/month**
- 460 MWh/year x 1.22 lbs CO_2/kWh = **560,000 lbs CO_2/year**



Financial Calculations

Average Energy Costs/Month from powering all Refrigerators and Freezers:[3]

Assuming average utility costs of $0.07/kWh in Atlanta, GA

- 38,000 kWh/month x $0.07 cents/kWh = **$3,000/month**

Based on the Department of Chemistry's Utilities Data Sheet[5]

	Carbon Emissions (lb CO_2/month)		Cost ($/month)	
	Before Freezer Challenge	During Freezer Challenge	Before Freezer Challenge	During Freezer Challenge
Average	631,000	630,000	37,500	37,500
Standard Deviation	28,000	26,000	1,600	1,500
Result	103 lb CO_2 saved		$11 lost	

Implementation & Current Status

Our team started an Emory Freezer Challenge to encourage best practices to reduced CO_2 emissions from the Chemistry department. The challenge was inspired by the North American Freezer challenge,[4] which identified a series of refrigerant management techniques to reduce CO_2 emissions. 5 labs from Emory's Department of Chemistry participated in the challenge. Each management practice was organized in a "Tiered" system, with higher tiers representing more sustainable practices. Labs were given points for each management strategy implemented. 3 energy consumption meters were used in three respective types of cold storage equipment to quantify the immediate savings from to the Emory Freezer Challenge. The meters allowed us to develop a loose model to approximate these savings (below).

Model Cold Storage Units Calculations from Energy Consumption Meters

Amount Saved = [Projected (CO_2 or Costs) over 3 months] - [Real Total (CO_2 or Costs) at end of 3 months]
Percentage Saved (see below) = [Amount Saved]/[Projected (CO_2 or Costs) over 3 months] x 100

Refrigerator — With good practices

CO_2	Cost
22%	21%

Freezer — After defrosting

CO_2	Cost
18%	18%

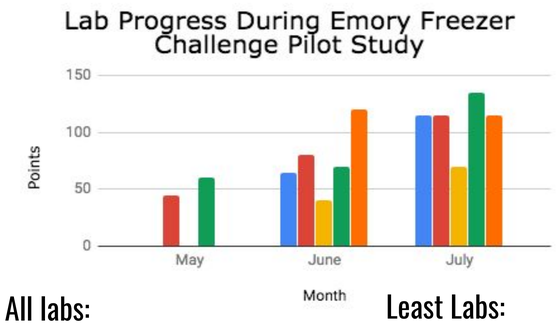
ULT-Freezer

With good practices

CO_2	Cost
30%	30%

And temperature tuning

CO_2	Cost
27%	27%



All labs:

- Promote short intervals of opening equipment doors
- Got certified under Green Labs at Emory
- Store samples at appropriate temperatures
- Clean out freezers and refrigerators

Least Labs:

- Defrost freezers during the Challenge
- Adjust set-point of ultra-low temperature freezers
- Retire or unplug unneeded/empty refrigerators and freezers

Future Plans

The next steps for this Carbon Reduction Challenge is to recruit new members via the ECAST infrastructure to continue and expand the Emory Freezer Challenge across campus. The Emory Freezer Challenge will continue to audit cold storage equipment and quantify carbon emissions. Refrigerant management will also be researched.

References

[1]Project Drawdown." *Project Drawdown*, 2014, www.drawdown.org/.
[2]Center for Sustainable Systems, University of Michigan. 2017. "Carbon Footprint Factsheet." Pub. No. CSS09-05.
[3]Dr. Berril Toktil
[4]"International Laboratory Freezer Challenge." *International Laboratory Freezer Challenge*, 1 Dec. 2016, www.freezerchallenge.org/.
[5]Emory University Department of Chemistry's Utilities Data Sheet, Sep 2016-present