Going Green at Georgia Tech Labs

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At Georgia Tech six research buildings, only 9% of the campus footprint, use 28% of the energy. We are reducing the energy consumption, beginning with the Petit Institute for Bioengineering and Biosciences (IBB).

Total Reductions

$23,405/year

256,756 lbs CO_2/year

=

1.5 tanker trucks of gasoline per year![3]

Fluorescent Drain to LED Gain

Electricity comprises 38% of the total energy usage by IBB. Over 50% of this energy consumption is due to lighting.[1] By replacing the fluorescent bulbs with LEDs, we aim to reduce the energy usage in the 8 lab wings and expand to all IBB.

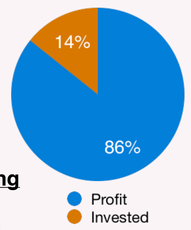
Type	Cost ($)	Lifetime (hrs)	Power (watts)	Electricity/year (kWh)	bulbs/wing	bulbs/building
LED 4 ft	3.69	50,000	14	51	438	3,504
Fluorescent 4 ft	2.2	30,000	32	116.8		
LED U-bend	19	60,000	15	65.7	24	402
Fluorescent U-bend	2.2	20,000	32	140.16		

Financial Savings

Calculations for one wing

Initial Cost: $4,470 (includes labor)
Savings on electricity: $2,078/year[2]
NPV: $11,954.05 (discount rate of 8%)
Payback Period: 2.15 years
Product Lifetime: 13 years[†1]
ROI: 602.08%
Annualized ROI: 16.17%

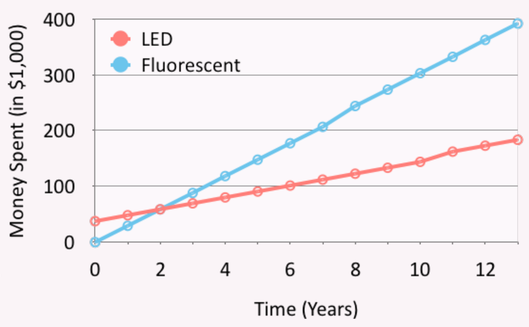
Profit vs Investment



Calculations for the entire IBB building

Initial Cost: $37,638 (includes labor)
NPV: $110,549.90 (discount rate of 8%)
Annual savings: ($2,078/(year*wing) * 8 wings)
+ ($10.12/(year*hall bulb) * 210 hall bulbs) = **$18,749/year**
ROI: 453.13%
Annualized ROI: 14.06%

Expense Over 13 Years



Carbon Savings

Carbon Savings for one wing

Electricity saved: (438 bulbs * (116.8 - 51) kWh/year) + (24 bulbs * (140.16 - 65.7) kWh/year) = 30,607 kWh/year
CO_2 reduction/year: 30,607 kWh/year * 0.98 lbs of CO_2/kWh[1] = 29,995 lbs of CO_2/year
Over LED lifetime: 29,995 lbs of CO_2/year * 13 years = **389,935 lbs of CO_2**

Carbon Savings for the entire IBB Building

Electricity saved: (3,504 bulbs * (116.8 - 51) kWh/year) + (402 bulbs * (140.16 - 65.7) kWh/year) = 260,496 kWh/year
CO_2 reduction/year: 260,496 kWh/year * 0.98 lbs of CO_2/kWh = 255,286 lbs of CO_2/year
Over LED lifetime: 255,286 lbs of CO_2/year * 13 years = **3,318,718 lbs of CO_2**

Co-benefits

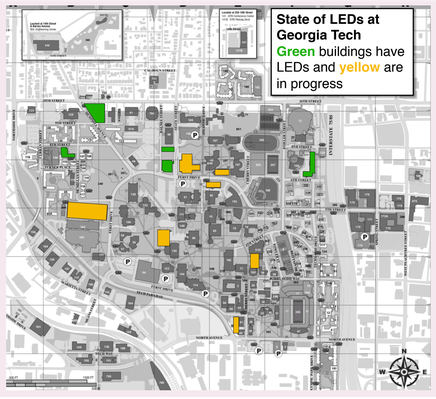
- Switching to LEDs prevents exposure to UV light and mercury
- LEDs are safe for landfill
- Decreased labor

Implementation

We are currently in contact with the Office of Campus Sustainability and Facilities for funding. A pilot project is in progress in wing 1B of IBB and will be completed in Spring 2020.

Next Steps

Working with Georgia Tech to switch to LEDs in the research buildings with fluorescent lights.



[†] **Uncertainty:** 1- from usage estimates. 2- for the plastic used in tips (polypropylene). 3- using the distance from a VWR supplier to Georgia Tech. 4- using the distance from Georgia Tech to the nearest incinerator. 5- for plastic incineration. 6- for powdered detergent. 7- using the distance from Grenova's supply facility to Georgia Tech

Save the 'Clave

Autoclaves use pressure and steam to sterilize equipment. Compared to home ovens, autoclaves take ~3x the energy per hour (6.6 kWh vs. ~2.4 kWh) and are used more frequently.[4,5]

Problem: These energy intensive machines are often run without using the full space (see Figure 1) and labs aren't pooling their own loads (see Figure 2).

Solution: Organizing the building to batch autoclave loads to reduce energy used.

In a 3 week liquid run pilot we reduced 1.67 runs/week
6.3874 kWh/run = 10.645 kWh/week
10.645 kWh/week * 52 weeks = 553.57 kWh/year

Financial Savings

Annual savings[2] **= $37.65/year**
NPV: $369.65 (discount rate of 8%)

Carbon Savings

Annual CO_2 savings[1] = **542.50 lbs CO_2/year**

Autoclave

Figure 1. Typical Load of IBB Autoclave Users**

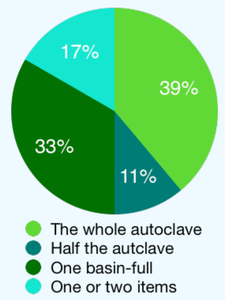


Figure 2. Prior Batching of Loads by Labs**

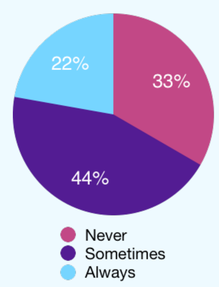
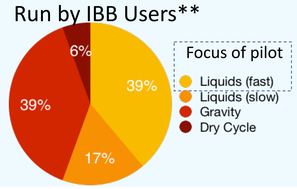


Figure 3. Typical Type of Run by IBB Users**



**based on IBB-wide survey results during the pilot program. n = 18

Co-Benefits

- Increased lifetime of the autoclave
- Organization in running the autoclave, more dependability for experiments

Implementation

- This pilot has been deemed successful and will be continued full-time by IBB
- Autoclave users are notified of program through SUMS

Next steps

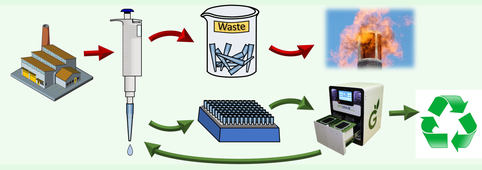
- Increase awareness, it took some time for people to catch on
- Expand to other types of loads that can be pooled (see Figure 3)
- Batch loads in other buildings

Too Many Tips Spoil the Lab

Pipette tips are plastic pieces that fit onto a pipette for the clean measurement of liquids

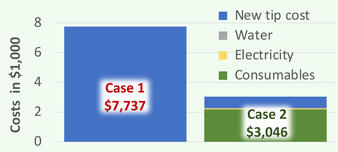
Problem: Georgia Tech disposes >10,000 lbs of pipette tips/year

Solution: Grenova Inc's pipette tip washer cleans and sterilizes tips for reuse/recycling without affecting tip accuracy



Financial Savings[2]

Annual Costs



Case 1: 0% washed tips for 50 people
Case 2: 90% washed tips for 50 people

Initial Cost: $35,000
Savings on tips: $7,737 - $3,046 = **$4,619/year**
NPV: $4,536.23 (discount rate of 8%)
Payback Period: 7.58 years
Washer Lifetime: 10+ years
ROI: 97.96%
Annualized ROI: 4.66%

Carbon Savings

No washed tips		100% washed tips	
Factor	**lb CO_2/yr**	**Factor**	**lb CO_2/yr**
Cradle-to-resin[6, †2]	751.3	Electric[1]	824.3
Shipping[7, †3]	43.0	Water[9,10]	65.9
Waste shipping[7, †4]	5.2	Consumable production[11, †6]	3.7
Incineration[8, †5]	1132.1	Consumable shipping[7, †7]	7.3
Total	**1931.6**	**Total**	**901.2**

Case 1: 0% washed tips for 50 people **Case 2:** 90% washed tips for 50 people

Case 1: 1,931.6 lb/yr
Case 2: (0.9 * 901.2 lb/yr) + (0.1 * 1931.6 lb/yr) = 986 lb/yr
Annual CO_2 Savings: Case 1 – Case 2 = **927.4 lb/yr**

Co-benefits

- Less incineration waste
- Tips can be recycled
- Fewer tip orders
- Clean tips on demand
- Less need to recycle tip boxes

Implementation

Received pricing from Grenova, IBB management is on board and has allocated a space, we are currently applying for mini-grants to fund the equipment

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References

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