

Sustainability On Campus

LED LIGHTING PROJECT

Total Costs



A. Electricity

| | <u>2006</u> | <u>2007</u> | <u>2008</u> |
|-------------------|-------------|-------------|-------------|
| Energy Used (kwh) | 199,712,753 | 196,735,521 | 191,130,490 |
| Total Cost (\$) | N/A | 16,739,390 | 19,796,373 |
| Cents/kwh | N/A | 8.5 | 10.3 |



B. Hot Water

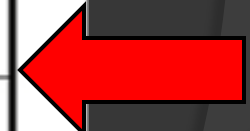
| | <u>2006</u> | <u>2007</u> | <u>2008</u> |
|-------------------|-------------|-------------|-------------|
| Energy Used (mcf) | 337,332.80 | 360,201.44 | 440,265.19 |
| Total Cost (\$) | 3,518,668 | 3,344,030 | 4,448,516 |
| \$/mcf | 10.4 | 9.3 | 10.1 |

Time Series Report



- Annual cumulative buildings total calculated from electricity, generators, and hot water groups

| <u>Year</u> | <u>2006</u> | <u>2007</u> | <u>2008</u> |
|--|-------------|-------------|-------------|
| eCO ₂ (tons) | 68,032.6 | 68,780.4 | 72,520.8 |
| Energy (MMBtu) | 1,028,173.8 | 1,041,350.3 | 1,103,911.2 |
| eCO ₂ , Percent of U of H Total | 46% | 45% | 47% |
| Energy, Percent of U of H Total | 51% | 50% | 52% |



| | A | B | C | D |
|----|-----------------|-------|------------|--|
| 1 | BUILDING LIST | ELEV# | BUILDING # | TYPE OF LAMPS |
| 2 | Agnes Arnold | 1 | 578 | 4 F32T8 |
| 3 | Agnes Arnold | 2 | 578 | 4 F32T8 |
| 4 | Agnes Arnold | 3 | 578 | 4 F32T8 |
| 5 | Agnes Arnold | 4 | 578 | 4 F32T8 |
| 6 | Agnes Arnold | 5 | 578 | 4 F32T8 |
| 7 | Architecture | 1 | 543 | 5 40 WATT INCANDESCENT |
| 8 | Architecture | 2 | 543 | 5 40 WATT INCANDESCENT |
| 9 | Architecture | 3 | 543 | 5 40 WATT INCANDESCENT |
| 10 | Cameron | 1 | 566 | 3 F20T12 |
| 11 | Communication | 1 | 568 | 4 F32T8 |
| 12 | Computer Cen | 1 | 566 | 4 F32T8 |
| 13 | E. Cullen | 1 | 516 | 8 1196 DC 12V 20W |
| 14 | E. Cullen | 2 | 516 | 8 1196 DC 12V 20W |
| 15 | E. Cullen | 3 | 516 | 1 90 WATT INCANDESCENT |
| 16 | Eng. D | 1 | 579 | 2 F32T8 |
| 17 | Eng. D | 2 | 579 | 3 F32T8 |
| 18 | Eng. D | 3 | 579 | 4 F32T8 |
| 19 | Eng. D 2 | 1 | 581 | 4 F40T12 WW |
| 20 | Eng. D 3 | 2 | 581 | 4 F40T12 WW |
| 21 | Farrish Hall | 1 | 587 | 4 F32T8 |
| 22 | Farrish Hall | 2 | 587 | 4 F32T8 |
| 23 | Farrish Hall | 3 | 587 | 4 F32T8 |
| 24 | Fine Arts | 1 | 599 | 1 F16T12, 3 F32T8, 1 F34T12 CW |
| 25 | Fine Arts | 2 | 599 | 4 F32T8 |
| 26 | Fine Arts | 3 | 580 | 3 F20T12, 2 F32T8, 1 F34T12 CW, 1 F32T8, 2 F15T12, 1 F40WW |
| 27 | Framing | 1 | 564 | 4 F32T8 |
| 28 | Herring | 2 | 564 | |
| 29 | Garrison Gym | 1 | 532 | 2 F32T8, 3 F30T12 |
| 30 | General Service | 1 | 585 | 2 F15T12, 2 F20T12, 2 F32T8 |
| 31 | Heyne | 1 | 534 | 3 F25T8 |
| 32 | HSC | 1 | 593 | 3 F32T8 |
| 33 | HSC | 2 | 593 | 3 F32T8 |
| 34 | HSC | 3 | 593 | 3 F32T8 |
| 35 | Kraus Hall Proj | 1 | 539 | 2 F32T8 |
| 36 | Kraus Hall Pass | 2 | 539 | 9 40 WATT INCANDESCENT |

read R2420

Current System

- Interviews and personal data collection have yielded the following:
 - UH has 119 elevators on campus, with 547 lamps of 22 different varieties.
 - They are composed of assorted fluorescents and incandescents of varying wattage and lifespans.



F32T8 tube light; most common with 258 in use

Why Elevators?

- ⦿ Efficient lighting is relatively expensive; elevators represent a practical investment that can still yield tangible, useful results.
- ⦿ Elevators lights are on 24 hours a day, 7 days a week
 - This costs UH in time for maintenance and for frequent purchasing of new lamps.
 - Replacements needed about every 8,000 hours, depending on lamp.



F13BX 13, found in SR
Classroom Building

The Numbers

- Elevator lights represent \$11,102.89 in yearly utilities, with possible increases with rises in the cost of energy.
- The upfront cost for purchasing current lamps is relatively inexpensive:
 - The most common lamp, the F32T8, costs UH about \$2.50 per lamp, including a 10% discount for purchasing in bulk.
 - Incandescents (of which there are few) are about \$1; the most expensive lamps are about \$5.

Note: Used 7.5 cents/kwh, per Sameer
(average residential cost = 11.5 cents/kwh)

The Numbers

- ◎ Each fluorescent contains about 20 mgs of mercury.
 - A dangerous neurotoxin, bulbs often break in landfills and during waste handling.
- ◎ Elevator lights contribute 198,382 lbs, or 99.1 tons, of CO₂ to UH's carbon footprint per year.
 - The average car burns 6 tons of CO₂/year.
 - Cumulative building emissions from UH is 72,520.8 tons of CO₂/year.

The Solution

- Light-emitting diode lamps (LED) would increase sustainability while saving the University of Houston money in the long-term.



A 17W LED tube to replace the F32T8

The Numbers

| LAMP | AVERAGE INITIAL COST | AVERAGE LIFESPAN | WATTAGE | TOXICITY |
|---------------------|----------------------|-------------------------------------|-------------------|----------|
| Fluorescent | \$2.50 | 10,000 hours (1 year, 52 days) | Primarily ~30W | Yes |
| Incandescent | \$1 | <1,000 hours (42 days) | 40-100W | No |
| LED | \$70 | 50,000 hours (5 years, 8 months) | 5-17W | No |

The \$ Benefits

- ◎ LEDs will pay for themselves.
 - The savings come primarily from efficiencies in utilities.
 - The F32T8 (238 currently in elevators) account for **\$452.32** in monthly utilities by itself – this translates to **\$5,427.80** in a year.
 - Meanwhile, the F32T8's replacement, a 17W LED tube that consumes nearly half the energy while lasting five times as long, accounts for **\$2,883.52** in a year – that's a yearly difference of **\$2,544.28** from one lamp.

The \$ Benefits

| LAMP | MONTHLY UTILITY COST | YEARLY UTILITY COST | COST OF OWNERSHIP OVER LED LIFETIME (\$ REPLACEMENT LAMPS) | LABOR COSTS OVER LED LIFETIME |
|-------------------------|------------------------|----------------------------|--|-------------------------------|
| Current System | \$925.34 | \$11,102.89 | \$10,663.50 | \$15,113 |
| LED Replacements | \$358.91 (\$566.43) | \$4,581.32 (\$6,521.57) | - | - |

Environmental benefits

- LEDs would also contribute about **76,934 lbs**, or **38.5 tons**, of CO₂, compared to **99.1 tons**, a 61% improvement.
- UH would qualify for an additional Tier 2 STARS credit.

Potential Costs

| LAMP | INITIAL COST OF OWNERSHIP | LABOR FOR REPLACEMENT | TOTAL |
|------|---------------------------|-----------------------|----------|
| LED | \$32,460 | \$2,380 | \$34,830 |

| LAMP | YEARLY UTILITES | YEARLY COST OF REPLACEMENT | YEARLY LABOR COSTS | TOTAL |
|----------------|-----------------|----------------------------|--------------------|-------------|
| CURRENT SYSTEM | \$11,102.89 | \$1,777.25 | \$2,518.83 | \$15,398.97 |

Break Even Point

\$6,522 – net yearly savings in utilities
+ \$1,777.25 – fluorescent replacement
+ \$2,518.83 – labor for replacement
= \$10,818.08 in net savings

\$34,830 (investment) / \$10,818.08
= 3.2 years until payback

Internal Rate of Return

- IRR = 19.85% rate per period
 - (initial cash flow of -\$32,460)
 - 5 cash flows of \$10,818.08 (of approx. 5 year LED lifespan), comprised of: \$6,522, the net yearly profit in utilities + \$1,777.25, yearly cost of replacing flourescents + \$2,518.83, yearly labor cost of replacing flourescents
 - Over lifespan of LED, UH would net **\$21,640** over initial investment.