

## SUSTAINABILITY MAKES FINANCIAL SENSE

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### Introduction

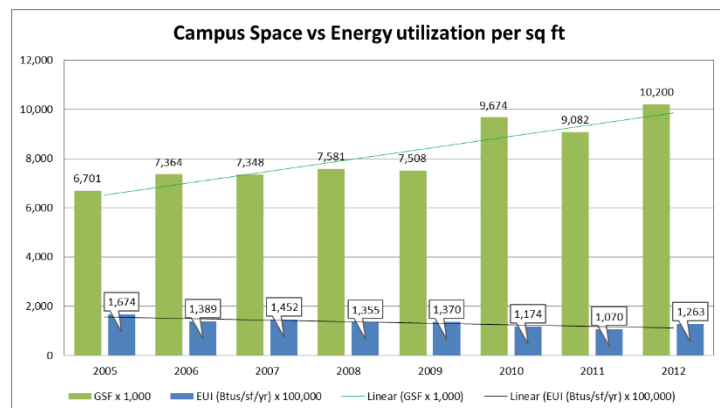
There are myths about sustainability that exist in the public mind which often make it difficult to pursue and embrace sustainable practices. Common myths about sustainability include: it costs a lot of money to do and needs to be handled separately with its own budget; it's only about recycling; and it's just not practical for everyone; etc. The University of Houston Facilities Management Department has developed a culture of empowering its employees to do pilot programs with a business sense to validate sustainability ideas in their own areas of control. This includes all facilities services, such as electrical, HVAC, irrigation, landscape, automotive, solid waste, etc. This sense of stewardship is encouraged at all levels of the organization.

In this paper we highlight three major impact areas which have become integral parts of a robust sustainable program: 1) Energy, 2) Water and 3) Waste Management/Recycling.



### Energy:

#### Energy Utilization Index (EUI):



Beginning in 2005 energy usage data has been collected. Through multiple efforts, the energy usage has shown a continual annual decrease. Building energy audits identify opportunities that lead to energy conservation. The data provided by the audits is for financial analysis of the proposed projects. These projects have allowed us to reap energy savings immediately.

We have achieved these energy savings through various project such as:

- Performance Contract with Local Energy provider
- Solar Energy
- Demand Response
- Lighting upgrades and controls
- Outdoor LED lighting projects
- Central Plant optimizations
- Heat recovery wheels
- After hour equipment shut off or resets
- Air Handler Units Fan and Pump speed control
- Condensate recovery
- On-going DDC upgrades and optimization
- Central Plant expansion and equipment replacement including variable speed chillers and pumps.



We have worked with our local electrical power provider to achieve year over year energy efficiency. In 2009 we received an award for commercial retro-commissioning from the energy provider. To date we have completed 19 Buildings through the local energy provider retro-commissioning program and the savings from those projects are listed on the Retro-Commissioning Projects Analysis 2006-2012 table.

Retro-Commissioning Projects Analysis 2006-2012		
Name	Year Built	Projected Annual Savings
G.D.HINES COLL.OF ARCHITECTURE	1986	\$36,785
CHARLES F. MCELHINNEY HALL	1971	\$5,541
COLLEGE OF TECHNOLOGY BUILDING	1977	\$71,578
AGNES ARNOLD HALL	1967	\$79,954
STEPHEN POWER FARISH HALL	1970	\$61,080
FINE ARTS BUILDING	1972	\$19,055
ISABEL C. CAMERON	1970	\$41,644
CULLEN COLL OF ENGINEERING 1	1967	\$32,955
JACK J.VALENTI SCHOOL OF COMM.	1977	\$4,903
C. W.MITCHELL CTR.FOR THE ARTS	1977	\$15,368
BATES LAW	1969	\$30,400
TEACHING UNIT 2 BUILDING	1975	\$8,263
MAX KROST HALL	1969	\$7,248
SCI. & ENG. RESEARCH CENTER	2005	\$38,397
A. D. BRUCE RELIGION CENTER	1964	\$1,720
COUGAR VILLAGE	2010	\$3,112
CAMPUS RECREATION & WELLNESS CT	2003	\$159,940
FRED J. HEYNE	1958	\$17,660
<b>Total</b>		<b>\$635,603</b>

Solar Energy:

Central plant offices are powered by Solar panels and used for educational tours in partnership with various campus colleges. The solar project cost was approximately \$140,000, paid for through a grant provided by Green Mountain Energy.



TOTAL SYSTEM SIZE: 16.32 kW  
 Modules: Commercial 240 W  
 Racking: Ballasted tilt-up on Flat roof  
 Module Count: 68  
 Installed Price / Watt: \$ 5.51  
 Equivalent kWh Rate of Solar System: \$ 0.1603/kWh  
 Annual kWh Production: 21,365 kWh  
 Monthly kWh Production: 1,780 kWh  
 30 Year Total kWh Production: 586,464 kWh  
 Percent of Usage Offset by Solar: 23 %  
 Environmental Benefits:

CO2 emissions prevented: 1,224,215 lbs. (555,294 kg) of CO2  
 Amount of river water kept clean from mercury poisoning: 1,089,615 gallons (4,124,641 L) of water  
 Equivalent number of CO2 absorbing trees: 2,564 trees  
 Amount of smog and acid rain causing pollutants prevented: 7,050 lbs. (3,197 kg) of NOx and Sox

Demand Response

When the State is in a crunch for energy on hot summer days, we shed electrical load by starting generators, thus reducing the demand on the electrical grid. The energy companies rebate cash directly to the University. This cash is used for energy saving pilot programs. Since 2008 we have participated in the Summer Demand response rebate program provided by local Utility provider. In 2009 we received a rebate check in the amount of \$60,000. Since then we have been steadily receiving rebate checks for the amount of load shed each year.



The program requires the participant to shed load within 30 minutes of the request call. In order to accommodate this program, the University had to install remote start capabilities on some of our generators at a cost of \$12,000. The payback period for this project was 0.2 years. This provides the capability to participate in other load shed programs like 4CP etc.

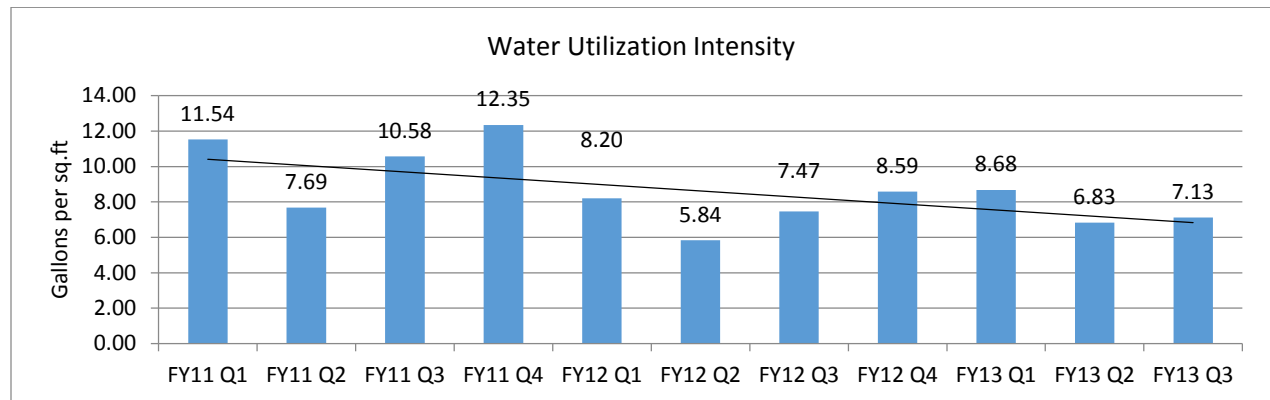
**Water**

Water Utilization

Sustainable landscape practices include water reduction for irrigation, installing plantings that are more drought tolerant, recycling landscape waste for re-use on campus and utilizing landscape maintenance practices that reduce the need for inorganic pesticides and herbicides.

Irrigation water reduction is a key component of increasing the overall sustainability of the campus landscape. Water reduction not only helps reduce the overall demand on the regional water system but also reduces the utility costs to the university. Water is wasted through several ways: irrigation run-off through over-watering, undetected leaks and breaks in the system and watering when it is not needed. The water leaks are treated as emergency repairs and sensors measuring ground moisture help in reducing the watering frequency.

Landscape plants are an important part of sustainability practices for any landscape. Choosing the right type of plant for the climate reduces the amount of water and other maintenance practices needed to keep it healthy. The Houston plant hardiness zone is 9a which indicates an average low of 20-25 degrees. Houston is also a very humid, semi-tropical climate with humidity and temperatures in the summer in the high 90's. Plants selected for this area need to be able to survive the high heat and humidity and occasional freezes. Preference will be given to plants that can thrive in this type of climate with minimal supplemental watering. Both native and non-native species can be utilized.



Unit conversion: 1 Gallon per square feet = 41.08 Liters per square meter.

Condensate Recovery

The University of Houston has many buildings with large, air-conditioned spaces requiring large amount of air to be cooled and moved thru the spaces for occupant comfort. Traditionally, the condensate removed from the airstream by the cooling coils has been lost and put into a building's drainage system.

Attempts at returning this condensate back to a point of reuse were thwarted by: a) distances from condensate drains to the point of reuse, b) routing through the building and c) costs to install these recovery systems.

The University has a 3.5-mile (5.63 km) series of underground tunnels linking the Central Plant to all major buildings on campus. A 4-inch (10 cm) diameter PVC line was installed in one tunnel and a reworked condensate line from rooftop units was connected to this underground line. A used tank, pump and flow meter assembly was repurposed and is now pumping clean air-conditioning condensate back into the 25,000 ton (22,679,619 kg) cooling tower system at the Central Plant.

A year-long study of the flow data was correlated with the cooling degree days for the Houston, Texas area. Based on this data and the current price of city water normally used for cooling tower make-up, the return on investment was calculated to be 12 cents per square foot of air-conditioned space.

The payback is 0.87 years. The initial cost is approximately \$6/ft. (\$19.2/m) of piping length. This saves 1,225,992 gallons (4,640,884 L) of fresh water per year and equates to \$11,929 per year in city water savings.

### Water filling stations



In an effort to reduce plastics going into our trash and eventually ending up in landfills, a pilot project was initiated by Facilities Management to install water bottle refill stations in classroom buildings. The water bottle filling stations replace the standard water fountains in existing locations and adds the benefits of incorporating a second water filter to the water supply and a bottle counter. This counter will give an indication of how many water bottles are not being tossed into the waste stream.

Cost per water filling station is \$2,528. Cost savings per year by not purchasing bottled water is \$5,008. The payback period is 0.5 years.

Environmental Benefits: Amount of Green House Gas reduced in 6 weeks from 2 locations: 4,638 lbs. (2,104 kg) (based on 0.55 lbs. (250g) / bottle of GHG released in the atmosphere due to manufacturing and transportation, GreenStar). Projected amount of Green House Gas reduced in one year from 35 locations: 230 tons (208,646 kg). Additionally, 2.3 tons (2,086 kg) of plastic is not directed into the campus waste stream.

### **Solid Waste Management/ Recycling**

Recycling is a key aspect of any sustainable solid waste management operation and effort, one that calls for the participation of the entire campus community. The University has an established recycling system that provides a solid infrastructure for a highly successful program. The campus-wide recycling program was initiated in October 2008 with a target annual recycle rate of 40% or greater per year by 2020. In 2012, the university recycled 25% of its total waste stream, by weight. A continued successful and high-profile recycling system which includes utilizing collection devices like the BigBelly© solar-powered units, will not only provide the University of Houston a chance to demonstrate its commitment to sustainability, but it can also provide significant cost savings, financial returns and lend to the aesthetic appeal of the campus built environment.

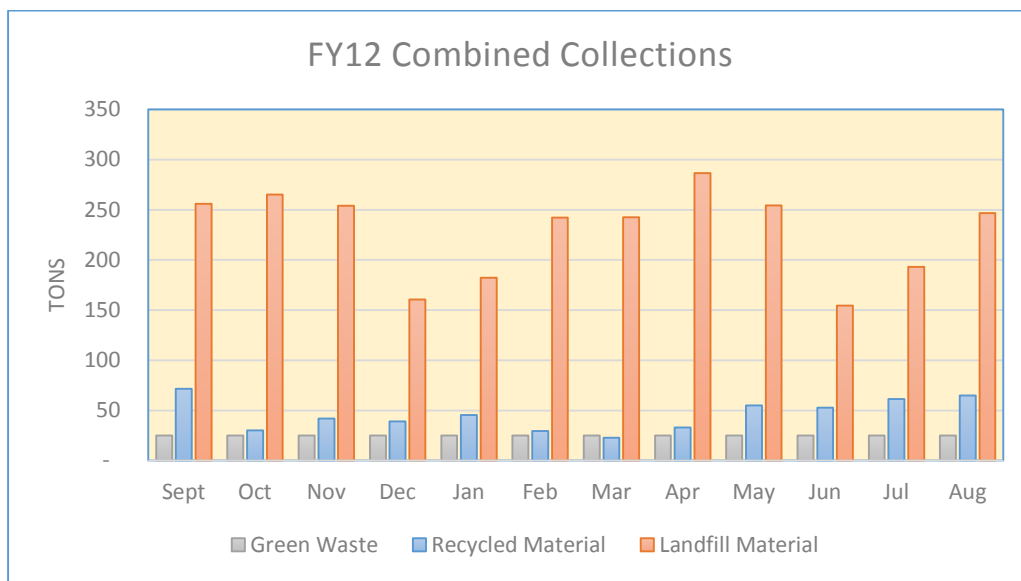
We started a pilot program in 2012 with installation of 13 BigBelly© solar-powered units. Each BigBelly© unit provides dual functionality collection – half of the unit holds regular trash and the other half holds recycling. Each unit replaces the capacity of 5 of the current concrete trash containers and 5 of the current large recycling containers located across campus. BigBelly© units add to the aesthetic appeal of the campus in several ways: 1) by replacing the current older, unsightly collection units; 2) their unique streamlined appearance; and 3) the units are designed to fully contain contents and avoid loose

trash/recycling from overflow. The Units “inform” the University’s Solid Waste Operations when they are full. Crews only collect trash when they receive notice. Fewer units to collect from, coupled with collecting trash when units indicate they are full, results in reduced labor cost and time, reduced fuel costs, and more efficient use of resources. Recycled waste that is collected is sold to various recycling companies helping provide additional revenue. Savings experienced will help solidify the recycling program as an investment and establish a sound campus-wide sustainability program

**Fun Facts of Big Belly:**

- 1) Side panels and front hopper cover are made from 100% post-consumer recycled car bumpers.
- 2) Including preventative maintenance, the average annual maintenance cost is less than \$50 per BigBelly® unit.

**Recycling data**



*Unit Conversion: 1 ton = 907.18 kg*

**Benefits of Big Belly units:**

It makes our campus look clean and enhances the aesthetics. There are no overflows since the units notify when they need to be picked up. The units are fully enclosed containers, which eliminate numerous problems created by wind, snow, rain and animals.

On average the units are picked up once a week instead of daily for the traditional trash containers. This reduces labor and fuel costs.

Each unit replaces 5 trash containers and 5 recycling containers. It improves campus aesthetic and cost. The units have wireless technology to report their status into the CLEAN (Collection, Logistics, Efficiency and Notification system) dashboard that gives UH insights for monitoring and route optimization. The units are scheduled to be picked up when the indicator light is yellow (on a green, yellow, red system, where red means full)



The compaction mechanism of the unit exerts 5.3KN of force, increasing the bin's effective capacity by five. This reduced the volume of trash to be disposed since the same amount of trash is compacted before sent to landfill. These units have made recycling more visible on campus.

**Financial Benefit:**

The units have a 1.8 year payback period. The labor savings will be reinvested in solidifying the recycling program into the buildings. Increased recycling will generate more recycling revenue for the University.

The Cost per Solar unit including installation is \$7,083 each.

The Savings from each unit is as follows:

The unit uses fewer but larger trash bags, saving \$58 per year. Due to reduced frequency of pickup the fuel cost is reduced by \$92 per year and results in labor savings of \$3,767 annually. This amounts to a total savings of \$3,916 per year per unit. The total Savings in 5 years per unit is \$16,416. Solar compacting trash bins have a 1.8 year payback period. They use solar energy thus reducing the use of fossil fuel. They reduce labor for waste management operations. They use smart technology to communicate when the waste needs to be picked up. These units have improved the waste management and recycling on campus.

**Conclusion:**

The traditional thinking that sustainability costs money rather than saves money is proven incorrect by the facilities management group at University of Houston. The examples given above provide insight into our "small steps approach" to sustainability programs. We have successfully come up with creative solutions. We aggressively participated in Demand Response program, commercial and industrial standard offer programs. We have received over \$500,000 over last four years from these programs. We have not only used our operations and maintenance dollars wisely to accomplish ongoing energy conservation projects but have also reinvested the funds from demand response and standard offer programs in growing/enhancing energy related project activities – many of these identified by our in house retro-commissioning (RCX) or local energy provider's RCX teams.

Our relationship and collaboration with our energy provider has not only helped us with the grants, savings, better EUI etc. but has also helped Energy provider in marketing successes of their programs in local community and to the State entities such as ERCOT (Energy Reliability Council of Texas). Besides CenterPoint and Green Mountain Energy grants, we have led projects from grassroots movements and in many cases from suggestions by our own staff and have not signed up with any major Energy Service Company (ESCO) to accomplish these for us.

In 2012 the University of Houston rolled all these small programs into an integrated Sustainability Program to provide a roadmap into the future. The success of this program depends largely on the extent of collaboration and teamwork between different units of Facilities Management and its University Partners. The vision of the integrated sustainability plan will transform Facilities Management into a sustainability leader and serve as a benchmark for other similar institutions.

**WE ARE UH**  
**We Think – Therefore We Are**  
**Becoming benchmarks of**  
**Service, Stewardship and Sustainability.**