DIPLOMA DE POSTÍTULO

DISEÑO DE EDIFICACIONES ENERGÉTICAMENTE EFICIENTES

Facility Management

DISEÑO Y ANÁLISIS DE INTERVENCIONES

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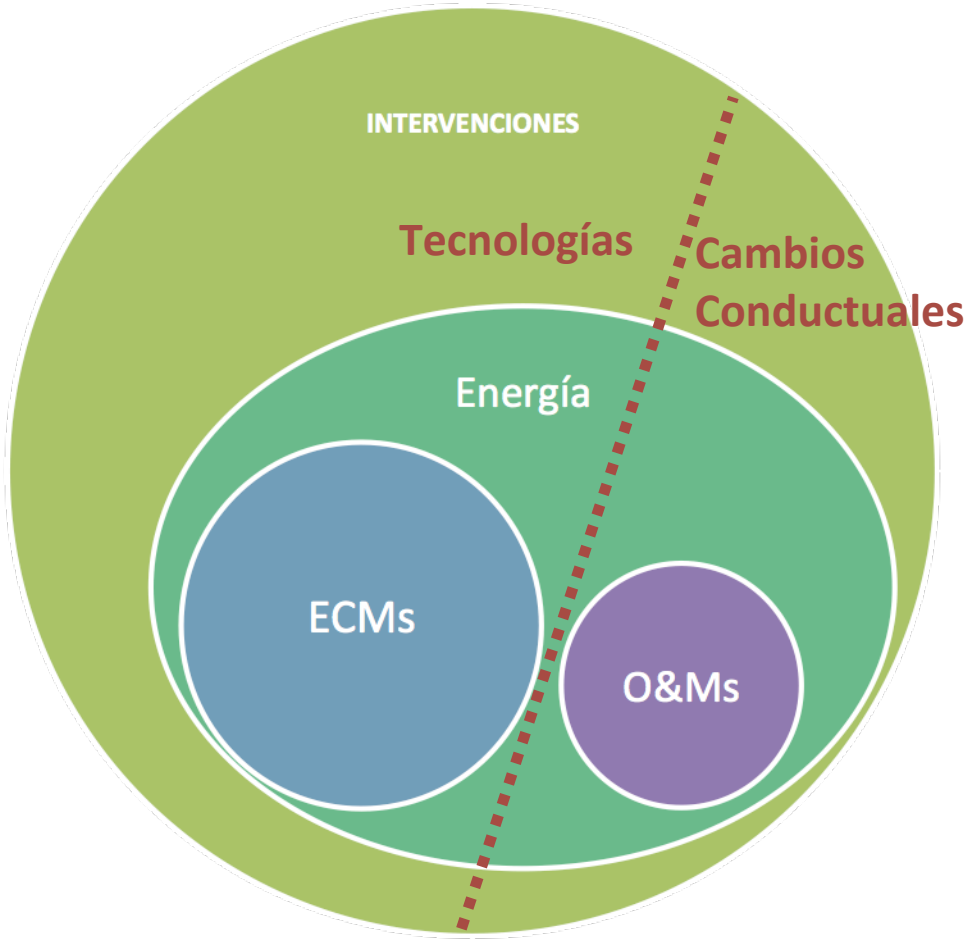
AGENDA

- ¿Qué es una intervención?
- Proceso actual
- "Bolsa de trucos"
- Proceso sugerido
- Impacto de reducción de consumos
- Ejemplos (programas pilotos)
  - SSH (4)
  - FCFM (reportes e implementaciones)

¿QUÉ ES UNA INTERVENCIÓN?

- Medida adoptada por el FM con la finalidad de reducir el consumo de servicios básicos en el edificio (o portfolio).
- Similar a ECMs u O&Ms pero con alcance más amplio que sólo ahorro energético.
- Tipos de intervención:
  - Tecnológica
  - Cambios conductuales

¿QUÉ ES UNA INTERVENCIÓN?

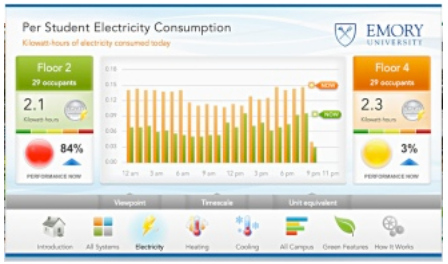


¿QUÉ ES UNA INTERVENCIÓN?

Tecnológica

- Forma más tradicional de concebir mejoras o ahorros en consumos de servicios
- Consiste en realizar un cambio tecnológico
  - Reemplazo (upgrade/cambio)
    - Ampolleta incandescente por CFL

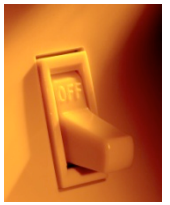
  - Adicionalidad
    - Agregar monitoreo y feedback a un servicio

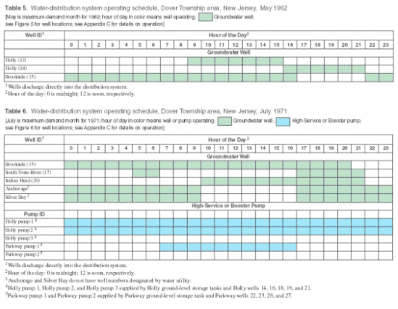


¿QUÉ ES UNA INTERVENCIÓN?

Cambios Conductuales

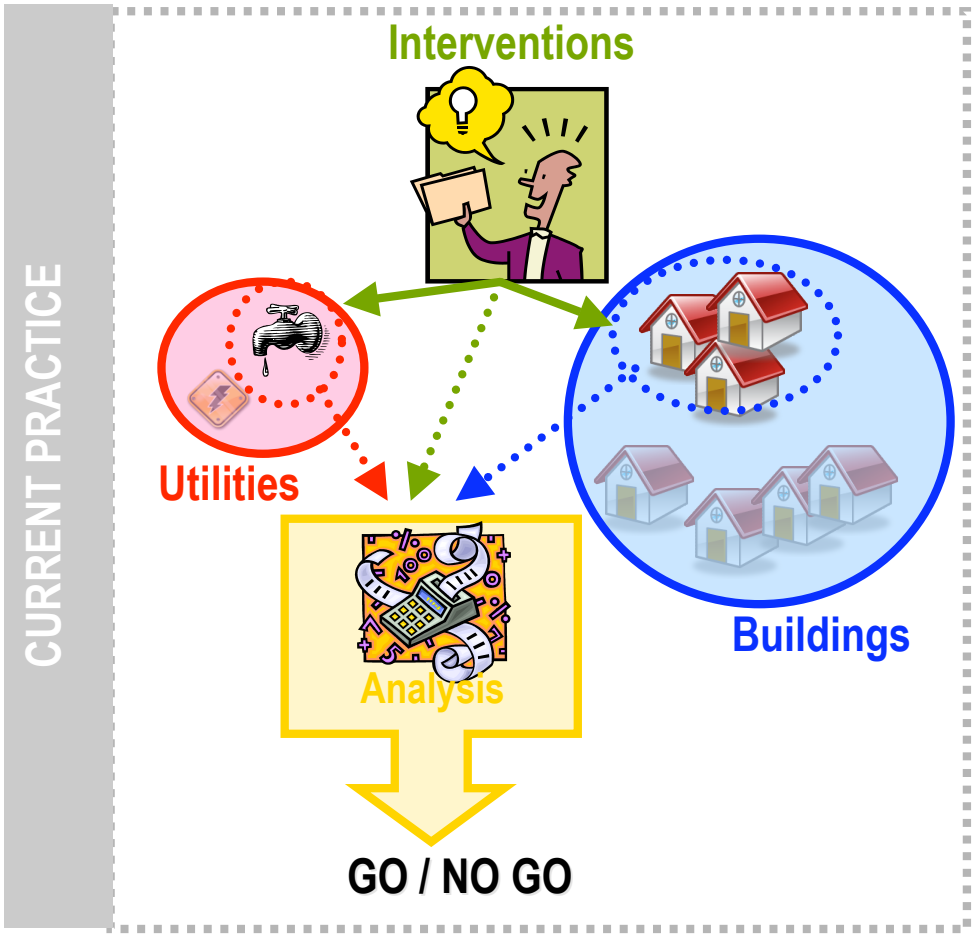
- Apuntan a modificar conductas de operación o uso del edificio con la finalidad de reducir consumo de servicios básicos.
  - Usuario final
    - Apagar las luces al salir de habitación
  - Facility Manager
    - Ajuste termostato (horario AC/calefacción)



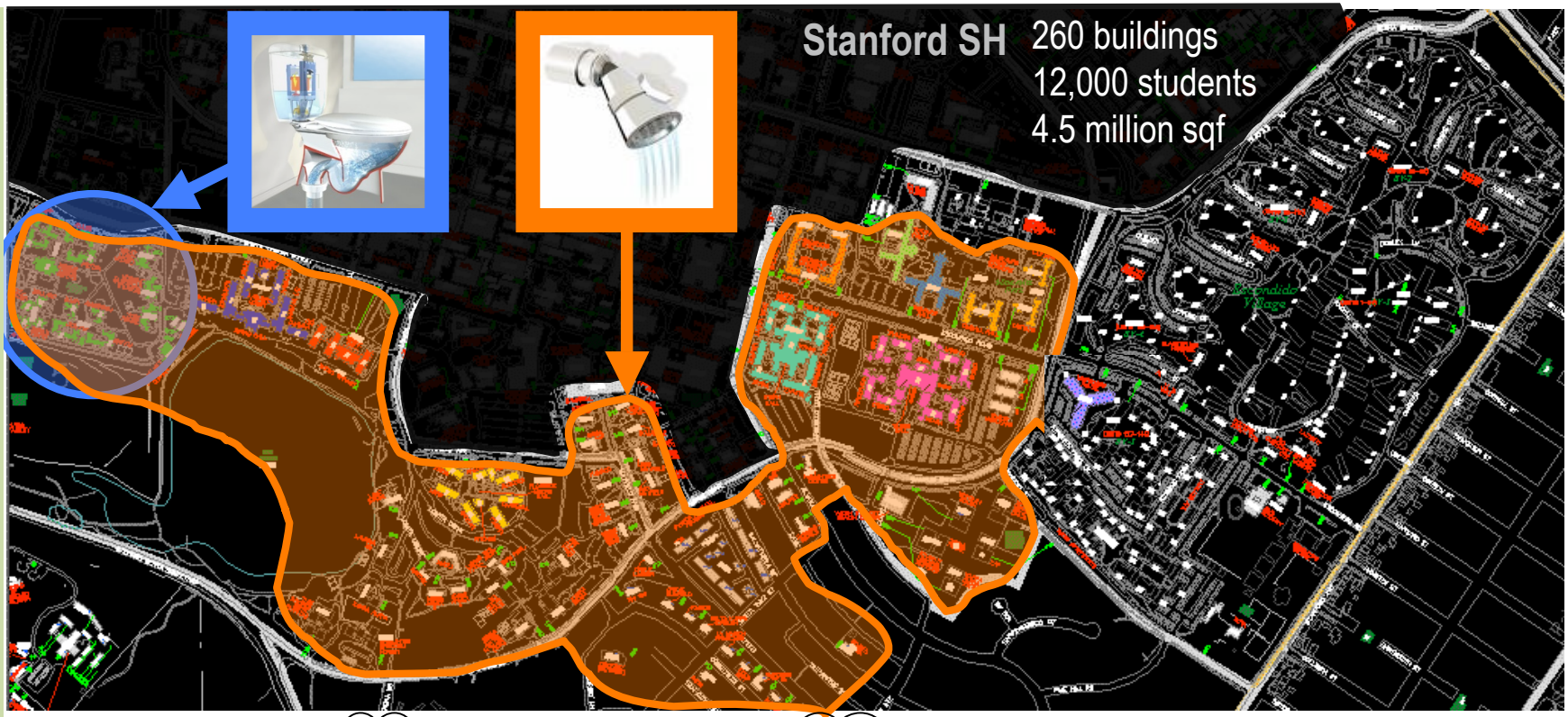


- Apelan a empoderar a los usuarios informándolos y/o educándolos

PROCESO ACTUAL



¿Dónde intervenir para reducir consumo de agua potable?

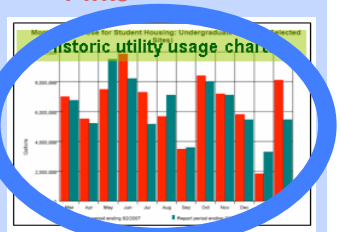


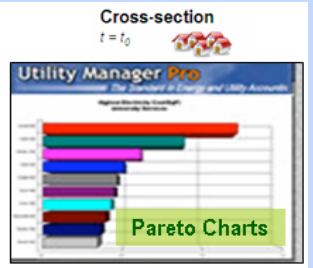
DISEÑO DE EDIFICACIONES ENERGÉTICAMENTE EFICIENTES

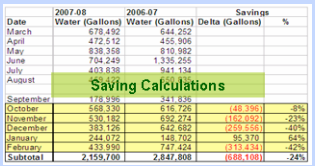
¿Dónde intervenir para reducir consumo de agua potable?

IMPLEMENT?
Y ☐
N ☐

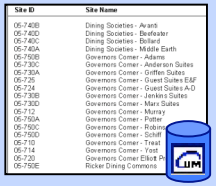
ANALYSES
4 wks



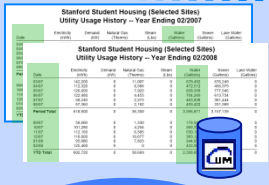




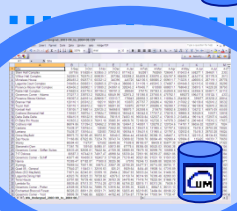
period
12 mo



buildings
19 / 260

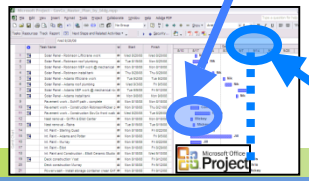


water usage



 # Residents

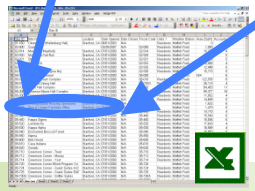
Governor's Corner
Spatial Proximity



Summer 2007
Temporal Proximity

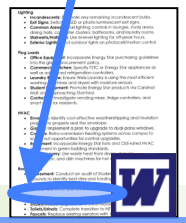
Capital Improvement Prog.

Governor's Corner
Bldgs Characteristics

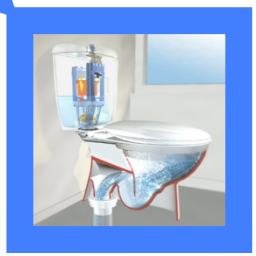


Type of Water Fixtures

Low flow toilets
Interventions

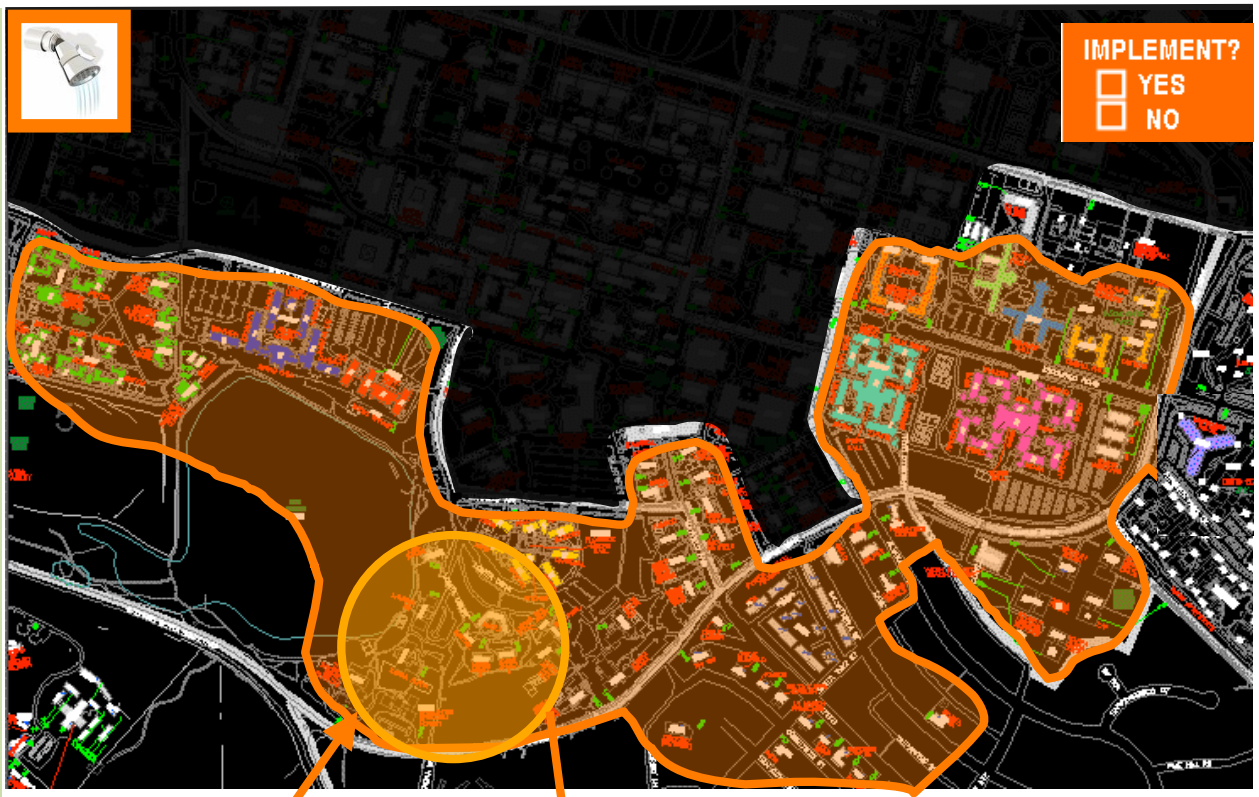


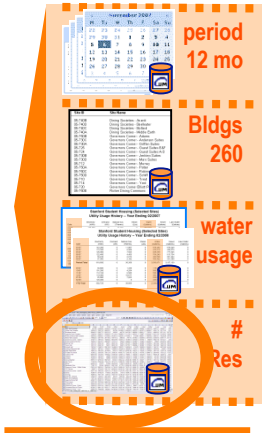
List of Interventions



DISEÑO DE EDIFICACIONES ENERGÉTICAMENTE EFICIENTES

¿Dónde intervenir para reducir consumo de agua potable?





Row Houses Pilot

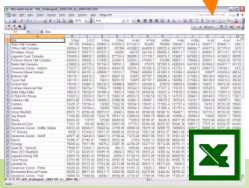
Student Projects

Bldgs Vacancy

Temporal Proximity

Student Engagement

Public Image



Students Initiated Project

Pilot Results

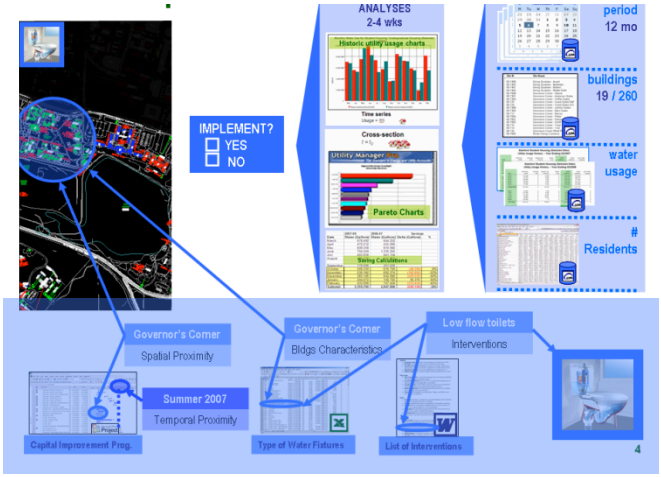
Academic Calendar

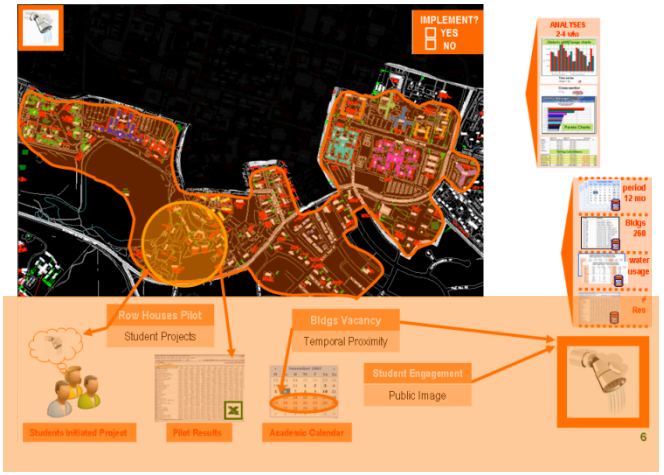
¿Cuál es el problema del actual análisis de las intervenciones?

	ABS [gallons/yr]	STU [gallons/student/yr]	SQF [gallons/sqf/yr]
AVERAGE CONSUMPTION @ SH	763,160	14,799	50
AVERAGE CONSUMPTION @ GOVCO	**476,229**	**6,257**	**28**

Desafíos para identificar dónde intervenir

• Infromación Dispersa		
– Documentos distintos	7	5
– Tipos de documentos dist.	4	2
• Informal		
– No portafolio	19	70
– Parcial o no benchmarks		
– Pocos o no requisitos operacionales		
– Método no formalizado		
• Tedioso y largo		
– 4 semanas por iteración	4	4





"BOLSA DE TRUCOS"

- FM habitualmente manejan "heurísticas" y listas de recomendaciones más frecuentes que típicamente han funcionado bien.
- Lista "low hanging fruit"
  - Stanford Student Housing
  - DOE
  - PPEE
  - Green Tips

"BOLSA DE TRUCOS"

Stanford Student Housing

Project	Program
Lagunita - dishwasher upgrade	CIP
Upgrade of commercial kitchens (Energy Star)	CIP
Irrigation sensing upgrade (Maxicom) – Governor's Corner	WRP
Undergraduate residences showerheads replacement (1.2 gpm)	WRP
Undergraduate residences low-flush urinals and toilets	WRP
Graduate Highrises and midrises toilets replacements (1.6 gpf)	WRP
Graduate residences showerheads (2 gpm) and sink aerator retrofit	WRP
Undergraduate lighting upgrade	ERP
Undergraduate occupancy sensors	ERP
Efficient mechanical motors replacement	ERP
Graduate housing (Rains) Energy Star refrigerators replacement	ERP

Project	Program
Undergraduate residences industrial refrigerator replacement (Bob, Italiana, Xanadu, Muwekma, Row houses)	ERP
Exit signage retrofit (from incandescent to LED)	ERP
Energy efficient Blackwelder boiler replacement	SHARP
Complete mechanical system retrofit for high rises – pumps, boiler, and pipes.	SHARP
dual pane windows replacement	SHARP
Escondido Village energy efficient boiler replacement	SHARP
Undergraduate dormitories radiant heat convectors – provide control to occupants	SHARP
Stern (Serra and Zapata) dual pane windows replacement	SHARP
Row houses Energy Star renovation of industrial kitchen appliances	SHARP
GovCo Cool Roof replacement – Adams/Robinson	SHARP
Roth- Solar system installation	SHARP
Cowell cluster - dual pane windows	SHARP
Midrise cool roof retrofit	SHARP
(10 bldgs) - re-roofing and roof insulation	SHARP

"BOLSA DE TRUCOS"

DOE (US Department of Energy)

- http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=11980

Appliances & Electronics
Designing & Remodeling
Electricity
Energy Assessments
Insulation & Air Sealing
Landscaping
Lighting & Daylighting
Space Heating & Cooling
- System Selection & Replacement
- Cooling Systems
- Heating Systems
- Heat Pumps
- Supporting Equipment

Water Heating
Windows, Doors & Skylights

Space Heating and Cooling

Heating and cooling account for about 56% of the energy use in a typical U.S. home, making it the largest energy expense for most homes. A wide variety of technologies are available for heating and cooling your home, and they achieve a wide range of efficiencies in converting their energy sources into useful heat or cool air for your home. In addition, many heating and cooling systems have certain supporting equipment in common, such as thermostats and ducts, which provide opportunities for saving energy.

When looking for ways to save energy in your home, be sure to think about not only improving your existing heating and cooling system, but also consider the energy efficiency of the supporting equipment and the possibility of either adding supplementary sources of heating or cooling or simply replacing your system altogether.

Selecting and Replacing Heating and Cooling Systems ▸
When replacing or upgrading an existing heating and cooling system, it's important to first consider the limitations imposed by your current system and available energy sources. When selecting a heating and cooling system for a new house, your options are generally much wider, although your builder or developer may place limitations on your choices.

Cooling Systems ▸
Depending on where you live, cooling your home can be as simple as opening a window or as complex as using a central air conditioning unit. A wide variety of cooling technologies are available.

Heating Systems ▸
Although most U.S. homes use either a furnace or a boiler, other approaches range from wood stoves to active solar heating systems.

Heat Pump Systems ▸
Heat pump systems provide both heating and cooling and offer the benefit of delivering more useful energy than they consume.

Supporting Equipment for Heating and Cooling Systems ▸
Thermostats and ducts provide opportunities for saving energy. Dehumidifying heat pipes allow central air conditioners and heat pumps to deliver drier air. Electric and gas meters allow you to track your energy use closely.

Lighting

Artificial lighting consumes almost 15% of a household's electricity use. Use of new lighting technologies can reduce lighting energy use in homes by 50%–75%.

You can reduce lighting energy use by selecting lighting and sources that use energy more efficiently, and by installing lighting controls.

Here you'll find the following information:

- **Lighting principles and terms**
  Lighting performance and design factors to consider for energy efficiency.
- **Lighting design**
  Basic indoor and outdoor lighting design principles and methods for energy efficiency.
- **Types of Lighting**
  Lamp types to consider and compare for energy efficiency.
- **Lighting controls**
  Controls to automatically turn lighting on and off as needed.
- **Lamp and ballast replacement**
  Replacing lamps and/or ballasts in light fixtures to improve energy efficiency.
- **Lighting maintenance**
  Basic maintenance to help keep your lights operating at their optimum energy efficiency.
- **When to turn off your lights**
  Energy-saving advice for when to turn off incandescent and fluorescent lights.

"BOLSA DE TRUCOS"

PPEE (Programa País Eficiencia Energética)

- http://www.buenaenergia.cl/576/propertyvalue-13313.html

PRÉNDETE CON ESTOS MENSAJES

Este cuadro muestra el gasto de energía de los electrodomésticos, el número de horas de uso y su gasto equivalente en número de ampolletas comunes y eficientes. Hay aparatos que consumen poco, pero su uso masivo conlleva a un alto consumo de energía. Ejemplo: En un hogar de 5 personas, con 6 ampolletas de 100 Watts encendidas 4 horas diarias, el consumo anual es de $66.576 ($5.548 mensuales). Además, en cada hogar hay entre uno y dos televisores, una lavadora y un refrigerador que consumen mucha energía. Este último está encendido permanentemente.

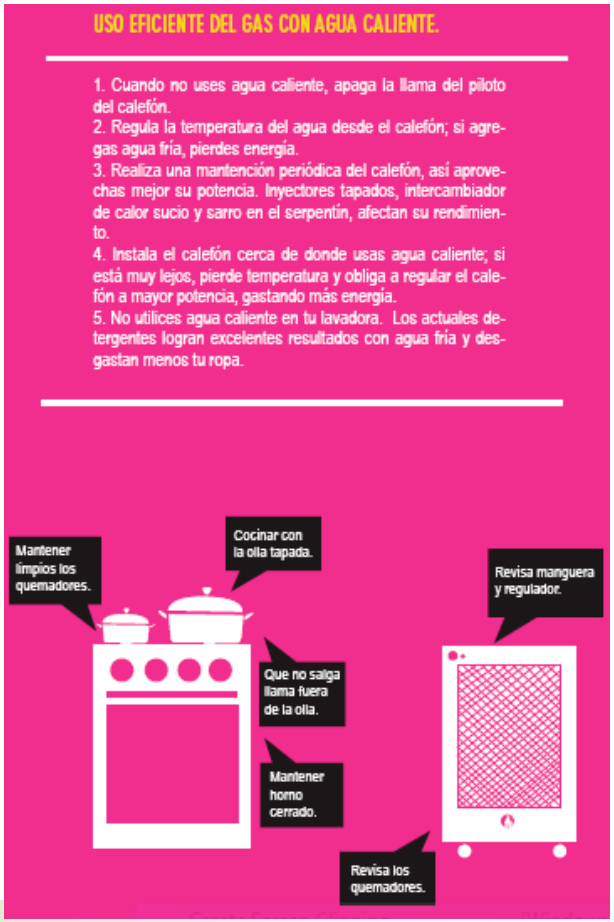
INFÓRMATE CUÁNTO CUESTA TU USO DE ENERGÍA

EQUIVALENTE 20W	EQUIVALENTE 100W	APARATO	POTENCIA (WATT)	HORAS DE USO SEMANAL	CONSUMO ANUAL * (KW hora)	PESOS**
5	1		100	28	146	11.096
3	1/4		65	56	189	14.364
3 1/2	3/4		75	4	16	1.216
18	4		350	2	36	2.736
20	4		395	8	164	12.464
20	9 1/2		400	21	437	33.212
43	9 1/2		400	3	62	4.712
50	10		850	3	133	10.108
50	10		1.000	2	104	7.904
75	15		1.000	1	52	3.952
75	15		1.500	2	156	11.856

*El consumo anual se calcula multiplicando la potencia de cada electrodoméstico por las horas de uso semanal y por las 52 semanas del año (Ej. La plancha: 1000x2x52=104 kW hora).

** El valor en pesos corresponde a $76 el kW hora (Año 2007).

Fuente: Chile Sustentable, en base a información de Salomon Thierry Stephane «La Maison des (nega) watts», Terre vivante, Francia, 2005.



USO EFICIENTE DEL GAS CON AGUA CALIENTE.

1. Cuando no uses agua caliente, apaga la llama del piloto del calefón.
2. Regula la temperatura del agua desde el calefón; si agregas agua fría, pierdes energía.
3. Realiza una mantención periódica del calefón, así aprovechas mejor su potencia. Inyectores tapados, intercambiador de calor sucio y sarro en el serpentín, afectan su rendimiento.
4. Instala el calefón cerca de donde usas agua caliente; si está muy lejos, pierde temperatura y obliga a regular el calefón a mayor potencia, gastando más energía.
5. No utilices agua caliente en tu lavadora. Los actuales detergentes logran excelentes resultados con agua fría y desgastan menos tu ropa.

"BOLSA DE TRUCOS"

Green Tips

- http://www1.eere.energy.gov/consumer/consejos/

Ahorro de Energía brinda consejos a los propietarios de viviendas para que puedan ahorrar energía y dinero en su hogar y en la carretera. En este sitio Web de Ahorro de Energía, encontrará algunos consejos prácticos para que haga de su hogar un lugar más confortable y más fácil de calentar o enfriar — al mismo tiempo que ahorra dinero. Nosotros le damos la información más reciente sobre tecnologías eficientes para el ahorro de energía. Incluso damos consejos para que la energía que requiera su hogar sea energía limpia y renovable.

Queremos ayudarle a vencer el alto precio del combustible con consejos sobre cómo conducir y mantener su automóvil para que ahorre dinero en la carretera.

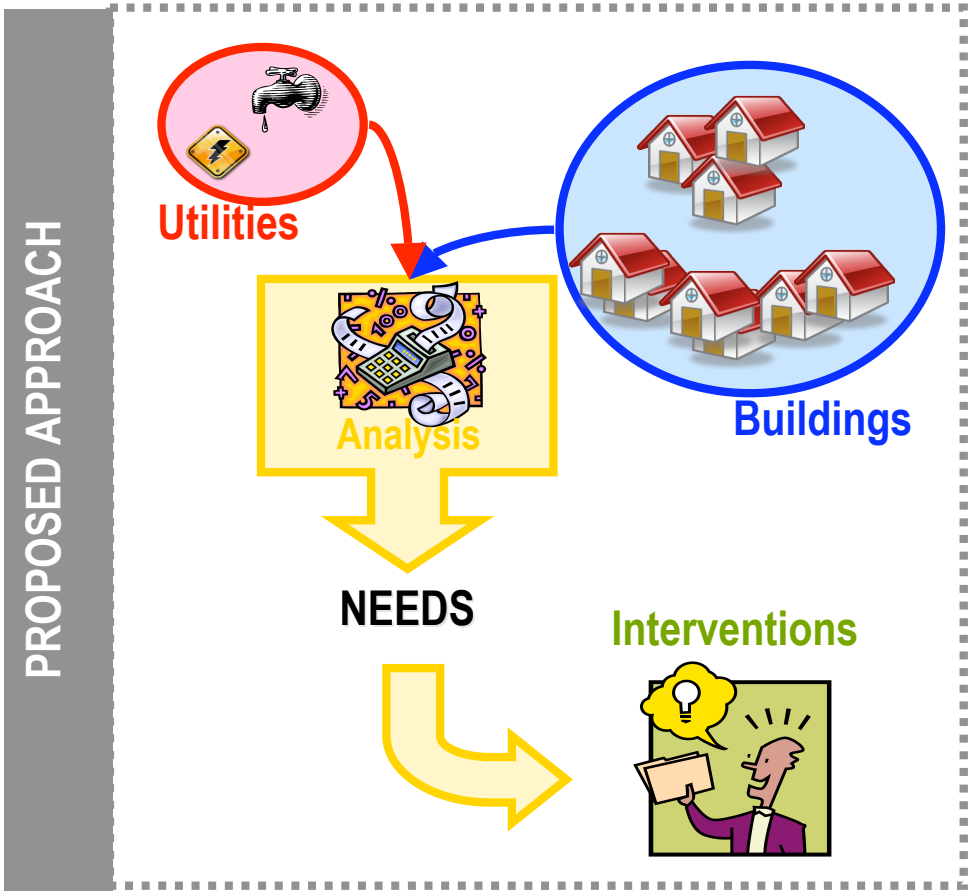
Algunos de los consejos son fáciles de seguir. Otros requieren esfuerzo de su parte y algo de inversión, pero siempre le favorecerán con ahorros considerables durante años.

Le animamos a informarse en nuestro sitio Web, para que desde hoy y antes de fin de año, haga las mejoras que contribuirán a que su balance energético final sea positivo, sin contar que ayudará a que nuestro planeta ¡Sea más saludable y limpio!

Visite energysavers.gov para obtener más información sobre las iniciativas de eficiencia energética en el hogar.

La información contenida en este sitio Web también está disponible en formato PDF (PDF 2.4 MB). Si no tiene el programa necesario, puede obtenerlo si hace un clic a continuación: Descargue Adobe Reader.

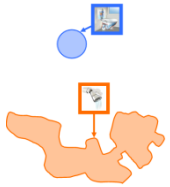
PROCESO SUGERIDO



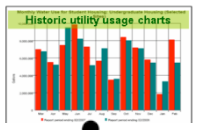
IDEF0 diagram

Conceptualización del problema

NO PORTFOLIO APPROACH



DISPERSE BLDG DATA



Identify underperforming buildings

NO FORMAL METHOD

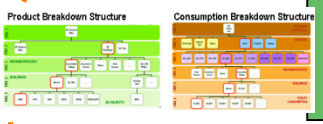
Inconsistent
Inaccurate
Time consuming

PARTIAL OR NO BENCHMARKS

TOO FEW OR NO OPERATIONAL REQUIREMENTS

AGENDA
- Presentación
- Sinópsis general del módulo
- Conceptos básicos
  - Caso 1: Stanford SH
  - Caso 2: FCFM
- Rol FM respecto a EE
- Prácticas habituales
- Método mejorado
- Clases que vienen

Modeling of product and consumption data



Model for PBS & CBS

Building portfolio

Energy & water consumption

Benchmark energy & water consumption

Weights: ***wij***
Requirements: ***Ri***

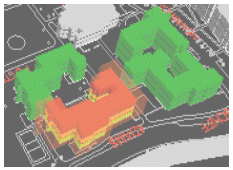
Assess operational requirements

Identify underperforming buildings

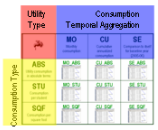
Display consumption & underperforming buildings

Formal representation

4D benchmark model that identifies underperforming buildings & displays consumption data



BM method



Method for portfolio benchmarking

OR Rule

Rule for operational requirement checking

Operational Requirement Rule

$$S_i = \omega \cdot Bu_i \leq R_i$$

Method for visualization of consumption data

IMPACTO DE REDUCCIÓN DE CONSUMOS

- **Effect of CIP on Utility Consumption: Years 1999/2000 to 2006/2007**
  - Últimos 7 años:
    - Ahorro de 500,000 kWh
    - Ahorro de 135,000 therms (gas natural) – 1 therm = 100,000 Btu
    - Reducción de consumo de vapor de 25% anual
    - Reducción de consumo de agua de 40%
    - Reducción de cuentas de consumo de USD$ 5.8 millones (acumulado)

IMPACTO DE REDUCCIÓN DE CONSUMOS

Impacto Global – SSH Portfolio

- Costo de consumo de servicios bajó y se estabilizó en 2001/02, pese a alzas de tarifas
- Reducción de electricidad y gas natural de 3% y 5%, respectivamente, pese a incremento de capacidad de 5% (562 estudiantes).

IMPACTO DE REDUCCIÓN DE CONSUMOS

Impacto Global – SSH Agua

Overall: *Water Use Down 36%, (Sewer 41%) Since 2000!*
Per Student: *Down from 72 gal/day (61) to 46 gal/day (36)*

- **Fixtures**
  - 4600+ Toilets
  - 4100+ Low-Flow Shower Heads
  - 1000+ Ultra Low-Flow Shower Heads
  - 4400+ Faucets
  - 98 Urinals
  - 50 Pre-Rinse Spray Valves
  - New Specs: 1.28 GPF Toilets, 1-Pint Urinals, 0.8/1.6 GPF Tank Toilets

- **Laundry**
  - 450+ Machine Replaced
  - 50% More Efficient
  - 20% Gas and Water Savings
  - 3,000,000 Gallons Annually

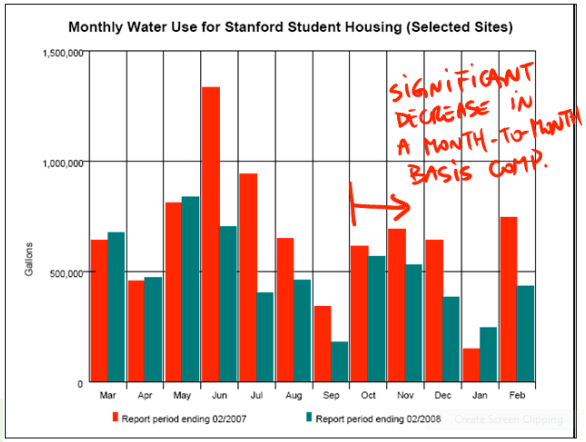
- **Irrigation**
  - Maxicom
  - Lake Water (Since 2000 @ Branner, Sigma Nu, Mrs, Columbae, Roble)

IMPACTO DE REDUCCIÓN DE CONSUMOS

Ejemplos Específicos

- **1. Toilets installed in GovCo in September 2007**
- 5 meses (Octobre 2007 hasta Febrero 2008)
- Ahorros:
  688,108 gallons of water (24% reduction).

	2007-08	2006-07	Savings	
Date	**Water (Gallons)**	**Water (Gallons)**	**Delta (Gallons)**	**%**
March	678,492	644,252		
April	472,512	455,906		
May	838,358	810,982		
June	704,249	1,335,255		
July	403,838	941,134		
August	459,422	650,835		
September	178,996	341,836		
October	568,330	616,726	(48,396)	-8%
November	530,182	692,274	(162,092)	-23%
December	383,126	642,682	(259,556)	-40%
January	244,072	148,702	95,370	64%
February	433,990	747,424	(313,434)	-42%
Subtotal	**2,159,700**	**2,847,808**	**(688,108)**	**-24%**

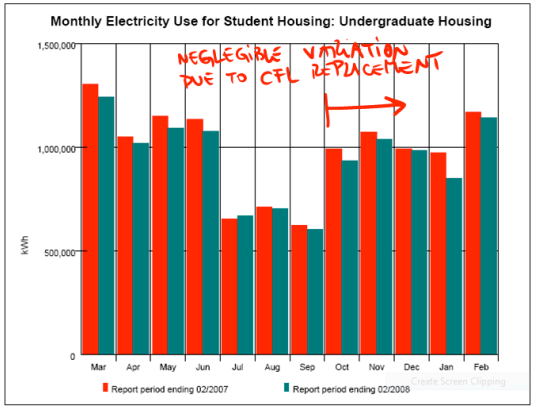


IMPACTO DE REDUCCIÓN DE CONSUMOS

Ejemplos Específicos

- **2. CFL's installed in undergrad in fall 2007**
- 5 meses desde el reemplazo de CFLs
- Ahorro undergraduate residences: 254,961 kWh (5% reduction).

	2007-08	2006-07	Savings	
Date	**Electricity (kWh)**	**Electricity (kWh)**	**Delta (kWh)**	**%**
March	1,243,730	1,305,738		
April	1,019,538	1,050,375		
May	1,093,491	1,150,093		
June	1,079,501	1,134,118		
July	668,283	652,241		
August	703,571	712,670		
September	604,095	625,407		
October	935,424	992,185	(56,761)	-6%
November	1,037,794	1,072,798	(35,004)	-3%
December	984,768	994,023	(9,255)	-1%
January	851,270	975,201	(123,931)	-13%
February	1,141,818	1,171,828	(30,010)	-3%
Subtotal	**4,951,074**	**5,206,035**	**(254,961)**	**-5%**

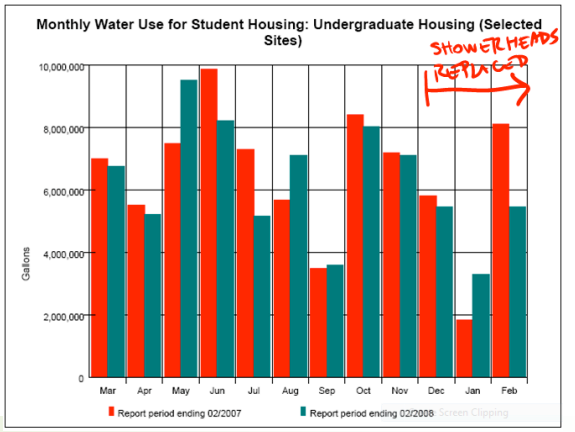


IMPACTO DE REDUCCIÓN DE CONSUMOS

Ejemplos Específicos

- **3. Ultra-low flow shower heads installed in undergrad in December 2007.**
- 2 meses consumo.
- Ahorro en undergrad residences of 1,166,904 gallons of water (12% reduction).

	2007-08	2006-07	Savings	
Date	**Water (Gallons)**	**Water (Gallons)**	**Delta Gallons)**	**%**
March	6,763,999	6,977,639		
April	5,204,982	5,509,814		
May	9,502,425	7,479,478		
June	8,205,632	9,868,650		
July	5,153,105	7,301,047		
August	7,101,260	5,653,750		
September	3,598,505	3,481,926		
October	8,027,259	8,409,549	(382,290)	-5%
November	7,107,967	7,174,262	(66,295)	-1%
December	5,465,681	5,814,487	(348,806)	-6%
January	3,300,548	1,823,280	1,477,268	81%
February	5,447,320	8,091,492	(2,644,172)	-33%
Subtotal	**8,747,868**	**9,914,772**	**(1,166,904)**	**-12%**



EJEMPLOS (PROGRAMAS PILOTOS)

FCFM

- Ver PPT adjunta

EJEMPLOS (PROGRAMAS PILOTOS)

SSH – Green Campus

STANFORD GREEN CAMPUS PROGRAM

SMART STRIP PILOT PROJECT
RYAN ROGERS, GREEN CAMPUS PROGRAM

1. DESCRIPTION OF PROJECT. This project explores how Student Housing can offset phantom loads by using Bits Limited's Smart Strips. Smart Strips are a type of power strip that sense the power draw from an item, such as a computer, plugged into a control outlet. When the computer goes to sleep the Smart Strip registers the current change in the control outlet and automatically turns off the energy flow to other outlets on the strip, thus stopping peripheral items from using energy even when turned off. Chi Theta Chi will be outfitted with 35 smart strips during Spring Quarter, in all bedrooms and some common spaces, as a pilot test of the benefits of smart strip technology for Student Housing. Energy use for Spring Quarter 2008 will be compared to energy use of Chi Theta Chi for the past year.

2. BENEFITS

- Educate residents about the impact of plug loads and phantom loads on electricity consumption.
- Decrease excess energy use on Student Housing's residences.
- Discounted price of smart strips, enables inexpensive deployment.

EJEMPLOS (PROGRAMAS PILOTOS)

SSH – Green Campus

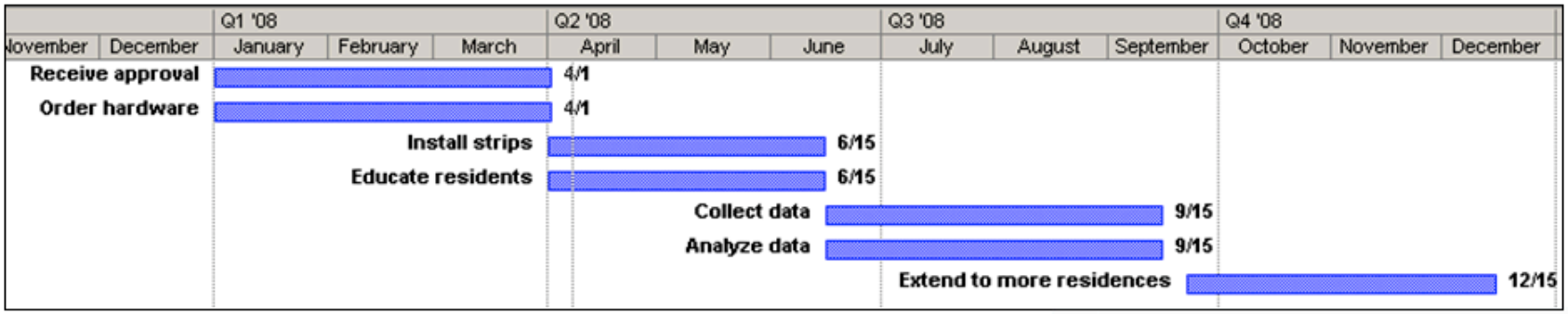
3. Impact on SH

- Students of Chi Theta Chi will be given a short briefing about phantom loads and how to use their strips by Scott Wilson, VP of sale for Bits Limited.
- Chi Theta Chi House Managers are environmentally inclined. They are very excited about the project and are willing to help monitor their installation, so there is no further impact on SH' staff or resources.

4. Costs & Possible Savings

- Smart Strips cost: $21.67 each x 32 strips (we already have three free of charge)= $780. Paid for by Stanford Green Campus Program.
- Bits Limited estimates that the average power usage of a workstation while turned on is 260W/hr. The average power usage while a computer is asleep using the Smart Strip is 30W/hr. Therefore, the average savings per hour per Smart Strip is 230W.

5. Proposed Timeline

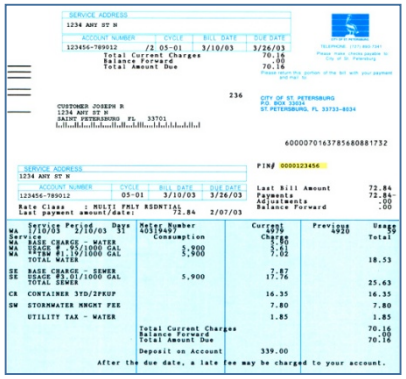


EJEMPLOS (PROGRAMAS PILOTOS)

SSH – Green Campus

STANFORD GREEN CAMPUS PROGRAM

MOCK UTILITY BILLS FOR STUDENT HOUSING
NOEL CRISOSTOMO, GREEN CAMPUS PROGRAM



1. DESCRIPTION OF PROJECT. Other than their Quarterly University Bill, Student Housing residents are disconnected from the cost of living, specifically energy consumption. This disconnection represents a tragedy of the commons, in which energy is wastefully consumed at the cost of the Cogeneration Plant and the environment, and Student Housing rates. The mock utility bill aims to educate students of the economic costs of electricity, natural gas, and water and their resultant carbon dioxide emissions so that students will connect daily consumption with quantitative costs.

2. BENEFITS

- Educate residents of the actual cost of energy, which they will experience to a greater effect if they were to live off-campus.
- Provide residents with a competitive incentive to conserve by ranking residences by their per-capita energy use and attempt to resolve the spike in energy use after the conclusion of the Conservation Cup.
- Determine the most effective types of feedback displays that are most effective in education and conservation efforts, as used in conjunction with John DuPont's electronic metering pilot project.

EJEMPLOS (PROGRAMAS PILOTOS)

SSH – Green Campus

3. Impact on SH

- Mock energy billing is a relatively easy way to quantitatively teach students about their impacts in accordance with SH's Living Green initiatives.
- Mock bills can be generated from consumption data stored in the Utility Manager software, therefore there is no impact on the residences.

4. Costs & Possible Savings

- Approximately $200 in Printing costs of hard copy mock bills to be posted in residences and advertisements in the Stanford Daily, to be paid by the Green Campus Program Budget.
- Possible energy and water savings from student behavioral change, to be measured in comparison to consumption from previous years, and through focus groups.

5. Proposed Timeline