Every Drop Counts

The Muffin Men

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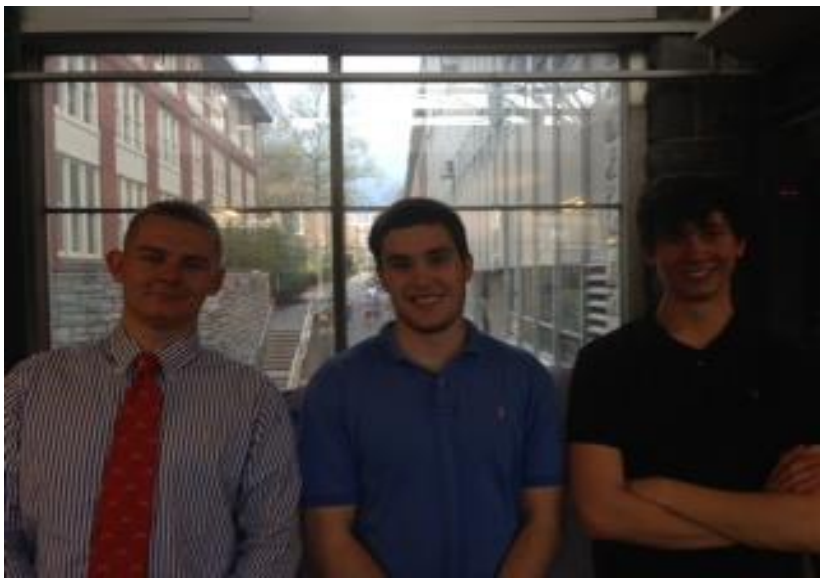

SIEMENS

Penn State currently uses 58.2 million gallons of water per year on campus. After surveying 72 students, a majority of them agreed that Penn State's water waste was coming from the bathrooms. These students said on average that they take 15 minute showers and are coming across faucets being left on half the time. Our group proposes to fix water waste with a three prong solution. The first step is installing Sink Positive units, which are a low flow toilet/sink combination that will save on average 2 gallons per person a day. Also, we included a poster in the bathroom showing gallon usage and included affordable shower heads that would take gallon usage from 4gpm to 1.7gpm. With 13,700 students the sinks will pay for themselves in 2 and a half years, and the Sink Positive in 13.

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Introduction:

Problem Statement:

With 13,700 students living on campus at Penn State, a significant amount of water is lost through bathrooms in living facilities. These bathrooms are currently equipped with wasteful showers and toilets which need to be upgraded to be cost efficient and conserve water

Sustainability:

Our group defined sustainability as the ability to survive a long amount of time off limited resources.

Ideation:

The goal of our project is to develop a sustainable campus. To be sustainable, the campus should be able to function on its own and have an infrastructure that will last and be maintainable for years to come. So to have a sustainable campus, we will need to have many components of infrastructure that are both green and efficient. These components could include sustainable housing and buildings, energy sources, transportation, recycling food, water, and means of managing human waste. It takes all of these components to have a sustainable campus. For our project, we wanted to look at the issue of water waste. We decided after brainstorming that the area where most students used water was in the dorm bathrooms. Just from living here we all see daily the amount of water that is wasted by all of our fellow students due to running faucets, toilets that use far too much water to flush, very high flow shower heads and so much more. We then took some photographs around the different dorms so that we could see and show just how out-of-date the infrastructure had become. We saw that many of the bathrooms were outdated to begin with, and have simply become run down. Many of the faucets drip or have leaks, and many shower stalls have leaking water temperature adjusters that spray water when the water is running. These facilities are in terrible need of renovation and if this is to happen it might as well be replaced by water and money saving alternatives. But also while we were out researching, we noticed that it seems as if someone is practically always in the shower. So we began to wonder, how often to people here at Penn State shower? How much water is being wasted? So we ran a survey online with our fellow students here at Penn State being the only ones able to take the survey. Our surveys showed that the typical Penn State student showered seven days a week once a day. With this, we had a great start into improving the water waste issue and making our water consumption much more sustainable.

Concept Development:

When faced with the challenge of creating a more sustainable campus via conserving water, our team to it upon ourselves to create and AHP matrix in order to visualize what we needed most out of solution. After the matrix was done it was clear that the most important thing was that our design needed to be efficient. It also became apparent the solutions we chose had to be cost efficient. The solutions would have to be efficient enough to pay for themselves in a reasonable amount of time. The solutions would also have to be user friendly, easy to install, and have an appealing design.

	Efficiency	Design	User Friendly	Installation	Cost	Total:	Weight
Efficiency	1	5	4	3	2	15	.38
Design	.2	1	.5	.25	.33	2.28	.06
User Friendly	.25	2	1	.5	.25	4	.10
Installation	.33	4	2	1	.5	7.83	.2
Cost	.5	3	4	2	1	10.5	.26

Now that our group knew what our design needed, we started to brain storm ideas we thought would help. We surveyed more than 50 students and determined that great deal of water waste comes from the bathrooms on campus. After discovering this we set out to find ways to conserve more water in the bathroom. We figured that water was wasted through showers, toilets and faucets. This gave us five ideas.

1: Sink Positive:

[1]Sink Positive

Sink Positive is a private company that sells custom toilet tank backs that also acts as a sink. When the toilet is flushed, clean water comes out the faucet, washes the hands and then they grey water is used to flush the toilet. This innovation not only uses let mater to flush, but it also saves water from faucets. Each unit cost 139$ and takes about 5-10 minutes to install.

[2]Tankless Water Heater

2. Tankless Water Heater:

A tank-less heater is like a normal water heater, but the heat water on demand instead of storing it in a tank. This causes the tankless water heater to be more efficient and save water. While they are more sustainable, the cost for them is high up to 6,000 for multiple units per dorm. The installation for these units is also high since there has to be multiple units strategically placed close to the bathrooms.

3. Water Saving Shower Head

The shower heads located around campus are very archaic. They are extremely old and do not use water in a sustainable way. The shower heads currently used are very high pressure and fill about 4 gallons per minute. There exists thousands of water saving shower heads from as low as 8 dollars per unit. Often time these units include bulk rebates. The installation and cost of these showers are low and the payback is high.

[3]Low-flow shower head

4. Automatic Faucet

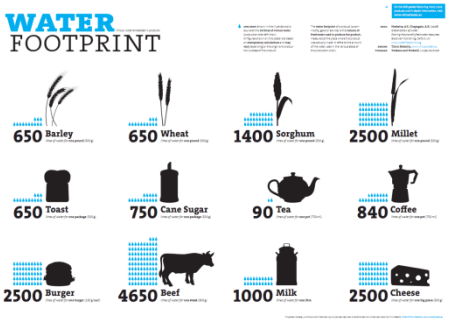
Our survey revealed that a number of students find faucets accidently left on. Also some people leave faucets on while brushing teeth, shaving, etc. We thought that installing new sinks in the dorm could solve this problem. These are expensive and hard to install.

[4]Automatic Sink

5. Poster

One solution our group thought of was a poster that informed people of their water foot print. The poster would include data on shower usage and how much water was waster in a certain time frame. We believe this would be a cheap and effective way to raise awareness and save money.

[5]Example Poster



[6]Selection Matrix

Constraint	Weight	Sink	Water Heater	Shower	Auto Faucet	Poster
Efficiency	**.38**	**4**	**5**	**4**	**3**	**2**
Design	**.06**	**2**	**4**	**4**	**5**	**2**
User Friendly	**.1**	**3**	**3**	**4**	**4**	**5**
Installation	**.2**	**5**	**1**	**3**	**2**	**5**
Cost	**.26**	**4**	**1**	**3**	**2**	**5**
Weighted Total		**3.98**	**2.9**	**3.54**	**2.76**	**3.68**

After Developing the Selection Matrix we found that the only solutions worth following through on were the Sink Positive, shower heads, and poster. The sinks and Water Heater were simply too expensive to buy and install. They simply would not have paid back their costs in enough time.

Once our group decided on the three best solutions based off our AHP matrix and our selection matrixes, it was time to research them in more detail. We had to research the designs and see how much they would save and compare it to the initial cost of the design and the installation.

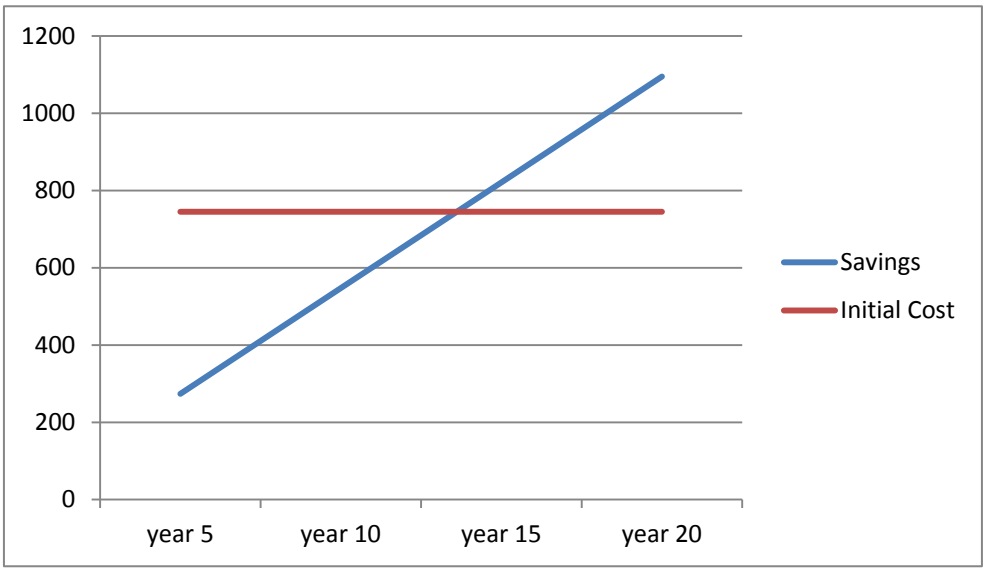
Detailed Concept Development:

Sink Positive:

The first problem with the sink positive was that it could only fit on the back of a toilet tank. The toilets in south, Pollock, west, and east halls all have tank-less toilets. This means that the only place where we could install the product was in Nittany Apartments, east view terrace and in suites in North halls. The sink positive costs 139 dollars. The installation would be very cheap, about 50 dollars. It is estimated that the sink positive saves two gallons a day per person.

Approximately 40 people use a bathroom in a dorm. Knowing these numbers this graph can be made.

[7]Sink Positive Savings



The initial cost represents the installation of 5 sink positives in a typical north hall bathroom or a bathroom in another dorm. The total for five sink positives and installation comes to be $745. The savings are calculated by the cost of a gallon times two gallons per person in the dorm per five years. After 14 years profit will be made. Each bathroom will save about 54.75$ a year. This is a very respectable payback time period. The new toilet tops would be more sustainable and eventually make the campus money. This makes the sink positive a very good solution because it is extremely easy to install and afford.

Shower Heads:

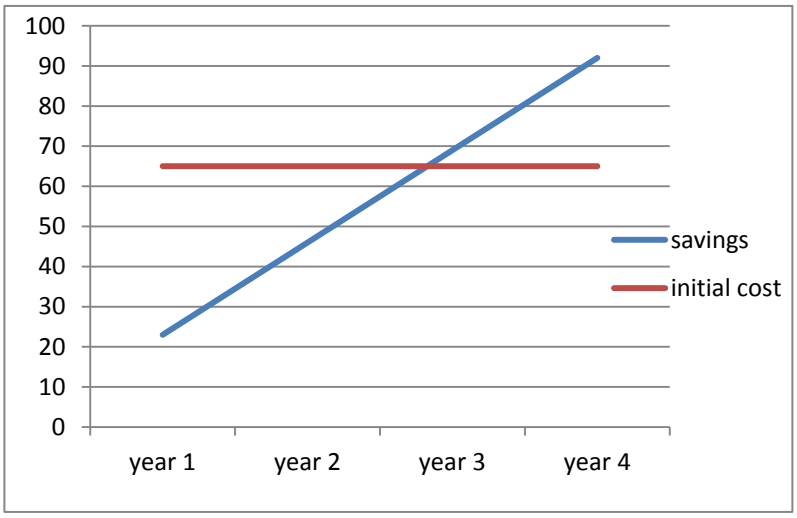
It didn't take our group long to find that there was a problem with the Penn state showers. Beside is a picture of a shower in east halls. This shower is basically an extension of the pipe. It is in no way sustainable. It simply buckets water on the user at a rate of almost 5 gallons per minute. This was good for 1981-1991 but since then the standard for showers is 2.5 gallons per minute. So not only would water suing showerheads save a good bit of money, but they would also be more efficient and user friendly.

[8]Dorm Shower Head

Hard numbers for the shower heads are shown below. It was calculate that a shower that costs 15 dollars could reduce water usage by up to 30 percent per shower. Taking this, and the cost of gallon, one can calculate exactly how much money would be saved by the shower head. The initial cost of the shower head and installation, $60, will be paid back shortly before the third year. It is also worth mentioning that this graph I for one person. At Penn State more than forty people could be using the same showers. This would make this payback period even shorter.

Penn State shower heads are the bare minimum in energy efficiency and sustainability. There exists hundreds of water saving alternatives to the old shower heads being used currently. Penn State owes it to themselves and to its students to make a change to their current shower heads.

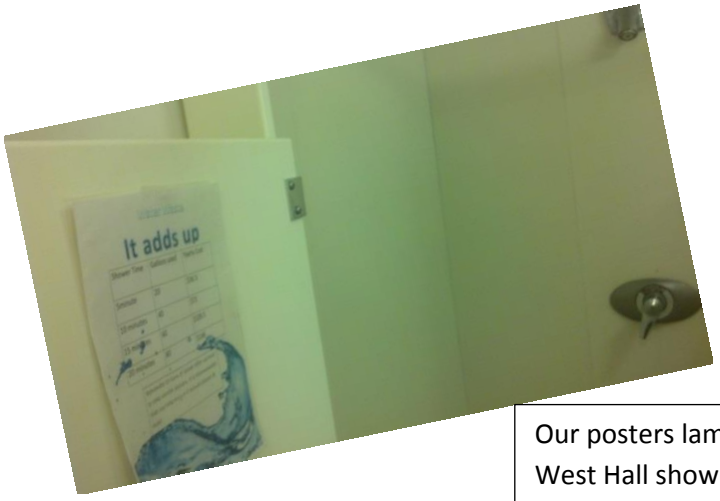
[9]Shower Head Savings



Presencing/Poster:

A very effective way to conserve and be more sustainable is a technique known as presencing. Presencing Is a social science that involves a blend of words and numbers that allows people to see a higher potential they can live up to. This method has been seen in many places. It is seen on tests when the average and high scores are posted, it is seen on high scores in games, and has also been seen in the Toyota Prius with is on mile per gallon tracker. The technique is not very expensive and complex, but it is effective. Our group realized this and decided to use presencing to raise awareness about how much time and money is spent while in the shower. Based on our surveys of students living on campus, we determined the typical shower a student takes is 15 minutes. Experts say that the max time needed in a shower is 5 minutes. This means that the ten minutes extra spent is unnecessary. To show this we constructed a poster showing how much a shower cot the school per year per minute of daily showing.

[10]Presencing Poster Photo #1



[11]Presencing Poster Photo #2

Our posters laminated and hanging in a West Hall shower stall. It cost only a few minutes of time and has potential to save hundreds of gallons around campus.

Another thing we heard many students say in the surveys was that they wished there were clocks in the bathroom to show how much time their showers were lasting. We saw this and believed it would be perfect to go with our poster. Now students could look at the poster and the 5 dollar wall clock hanging in the bathroom and be able to make correlations about how much they are wasting. It would be a perfect way to inspire students to conserve and help make the campus more sustainable.

Conclusion:

Our design has many advantageous features. For sink positive, the combination of sink and toilet is a change which is simple enough to be accepted by the public, while saving water. It also increases hygiene by promoting hand washing. It also is fairly cheap and very easily to install. The other aspect of our design, the shower redesign, can also provide a very viable solution to water waste in dorm bathrooms. It does this not only from forcing people to use less a water (low flow shower heads), but it also makes them more aware of their bad habits through presencing. Both aspects of our design were very effective in meeting our most important goals of being efficient and cheap. We do believe our design could be adopted by Penn State, especially the shower redesign. With many initiatives already taking place in dorms, the posters would not be a problem. Changing the shower heads would not be much of a problem either. Sink Positive may be a little more challenging to apply logistically, but it could potentially be used. A significant lesson we learned is that saving water actually ends up saving a large amount of electricity. So by saving water, not only are we preserving water itself, but we are reducing electricity. The biggest lesson we learned from this project was that there a ton of things which can be easily done by Penn State to be more sustainable. There are so many aspects of campus which can be improved upon even though many things have already been done. Great ideas are just the start.