
# Team Energy
# Final Report
# Spring 2014

**Team Leaders:** Amy Tat and Natalie Shahbol
**Team Members:** Katie Luong, Annie Cheng, and Kenyon Chow
**Stakeholder:** Sayros Yadgar, Associate Engineer for Energy Services in Facilities Management

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**Executive Summary**

Every year the ART Energy Team has the opportunity to explore the expansive field that is energy. As the 2014 Energy Action Research Team, this proved to be one of our biggest challenges, but also one of our biggest rewards because it allowed us the opportunity to find a project that the team is truly passionate about. Energy is everywhere and there is so much that can and should be done to make it more efficient.

The main objective of our team for the past two quarters was to improve energy efficiency on campus and educate the UCLA community about conserving energy, while supporting a healthier lifestyle. With our stairs-taking campaign, we aimed to change the behavior of the UCLA community, which we felt relied too heavily on using elevators over taking the stairs.

In addition to our "Take the Stairs" campaign, we had the opportunity to educate the UCLA community about energy efficiency at the Earth Day Fair. In creating a jeopardy game, we were able to engage students with useful and sometimes shocking facts related to energy usage and efficiency.

Lastly, the energy team collected data on the energy generated at UCLA's second annual Ecochella, a bike-powered concert. Team Energy is slowly but surely creating a database that can be used by the public—especially the Ecochella committee—to quantify the energy generated and saved by a bike-powered concert. This database can also be an educational tool for the UCLA community as it is a representation of the effectiveness of alternative forms of energy. All of the work done by our team this year was done with benefits and improvements to campus energy sustainability, economics, and health in mind.

**Significance/Background**

Past Energy Teams have expressed similar difficulties in choosing their focus area as well. The first ART Team to focus on energy was the Green Living Project: Energy Team in 2009. Their main goal was to survey the energy usage of UCLA's on-campus residents and to find ways in which efficiencies could be implemented. It was found that many residents were not using their own electronics efficiently and this team focused on generating awareness through stickers and even suggested a website that students could access to monitor energy usage. An ART Team created the Hill Energy Metering Project (HEMP) in 2011. Following the footsteps of their predecessors, HEMP focused on the energy usage of UCLA's on-campus residents as well. This team also found success in placing stickers reminding Hill residents to reduce their energy usage. The Energy Team of 2012 moved off of the Hill and into the Engineering building to reduce the energy usage by replacing existing light bulbs with lower wattage bulbs. The Energy Efficiency Team of 2013 finalized a main project that involved collaboration with UCLA's largest sustainability organization, E3. Last year, ART monitored bike generators and collected data at UCLA's first ever bike-powered concert hosted by E3.

ART Teams that have focused on energy efficiency in the past have all produced a very different final product. With the broad nature of this subject area, that is no surprise. Although we created a project unique to this year's team with a "Take the Stairs" campaign, we aimed to continue and build upon ART projects of the past, such as working with and collecting data at Ecochella to create a strong dataset for a unique event that could easily become a great UCLA tradition. Optimistically, future Energy Teams will be able to build upon our stairs taking campaign.

There are so many facets of UCLA life that could be changed to make this campus more energy efficient, as demonstrated by the many different ART projects produced by the energy teams throughout the years. With the UCLA Grand Challenges initiative, UCLA has set a goal for 100% renewable energy use--not just for UCLA but also for the Greater Los Angeles Area, by the year 2050. Some of these energy goals include:

- A smart electrical grid and metering system so energy can be fed back into the general power grid
- "More efficient energy production and storage technology"
- And "solar energy on every rooftop" (Hewit).

As the need for an Energy ART Team is clearly present, so is the potential for a true impact on the UCLA campus by the Energy Team. Our team's main focus was to be more energy efficient while encouraging a healthier lifestyle, which is presented in our main project and in our continuance of working with Ecochella.

The sustainability of energy and the sustainability of ART were two issues that were addressed by our team. In encouraging taking the stairs over elevator usage, we worked towards conserving energy. In building upon the project of last year's ART Team we have worked towards sustaining ART efforts to create a more lasting impact. The effectiveness of ART projects can only be sustained if we continue to work on projects already in existence rather than starting anew each year. In understanding this to be a major issue with the lack of sustainability in briefly successful ART projects of the past, we have made a conscious effort to sustain energy and to sustain the effectiveness of the Energy Action Research Teams.

**Objectives/Project Goals**

The Energy Action Research Team began work as a team by brainstorming the different changes that could be made on UCLA's campus to make it more energy efficient. With the help of our stakeholder, Sayros Yadgar, who is an associate engineer for Energy Services in Facilities Management at UCLA, we contemplated ideas involving vending machines, gym equipment, and window insulation before we decided on our main project, saving energy through reduced elevator usage.

After much consideration, our team decided to implement the "Take the Stairs" campaign. We aimed to create a culture of stairs taking on the UCLA campus to address sustainability, economics, and health. Our campaign was created in order to inform the UCLA community on the benefits of taking the stairs instead of the elevator and to inspire the use of the stairs. Although behavioral changes have the power to make a real impact, sustainability cannot be accomplished in addressing only the environmentally conscious UCLA community. Therefore, our project aimed to reach out to the health conscious and economically conscious UCLA community as well. Decreased elevator usage would save energy which would lead to savings in electricity costs and maintenance costs, and an increased usage in stairs would make for a healthier UCLA by providing cardiovascular exercise to those who choose this option.

In choosing the Math Sciences building to be our focus point and after speaking with the Chief Administrative Officer of the building, Ronke Epps—who was very supportive of our project—we were given the go-ahead to start collecting data. We have done so by collecting data on stairs and elevator usage with the use of kilowatt-hour meters in one elevator and occupancy sensors in two nearby stairwells. Our findings were to show whether or not elevator usage

decreased after the implementation of our campaign. Ideally, our campaign would result in a more healthy, energy efficient, and economically beneficial campus.

## Initial Conditions

*"Take the Stairs" Campaign*

Many UCLA students frequent the Mathematical Sciences (MS) building throughout each day. At the east entrance on the fifth floor, the focal point of our study is an elevator directly adjacent while the nearest stairwell is further down the hall. The decision to take the elevators or the stairs often needs to be made as people travel between floors. Oftentimes, people decide to wait for an elevator to arrive instead of taking the stairs. A "trip" is defined as each time the elevator is called to a floor. The initial phase of our data collection involved evaluating elevator trip counters. Trip counters found in two elevators in the MS building over a 35 day time period totaled to 57, 850 trips, averaging to 1,653 trips per day.

Two occupancy sensors were placed in the MS building—one in the east stairwell on the $5^{th}$ floor and one on the west stairwell on the $4^{th}$ floor. The occupancy sensors in the stairwells showed an average of 66.7 groups of people (occupancy sensors count groups of any size as one) entering the west stairwell each day during the control data collection phase, and an average of 66.1 groups entering the east stairwell daily.

*Earth Day Fair*

As did all of the ESLP Action Research Teams, we attended the annual UCLA E3 Earth Day Fair and hosted an energy efficiency informational table. Our table consisted of a trivia game used to educate Earth Day Fair visitors about renewable energy and ways to save energy at home and in general.

*Ecochella*

To continue the data collection of last year's Energy Efficiency team, we attended Ecochella, a bike-powered concert hosted by E3, on May 9, 2014 in order to collect data on the energy generated by the bikers. This year, an engineering competition was added to Ecochella, which were used as bikes to generate power, in addition to other rented out bikes. These bikes are connected to generators so that as bikers pedal, electricity is generated for the amps, microphones, speakers, and any other electronics onstage. Bikers must constantly generate enough energy to power all electronics onstage. A meter, which showed a green bar when bikers were generating enough energy and red when they were not, served as a visual to help them determine whether to pedal faster. The display board, unlike last year, when it showed the number of watts bikers were generating at each moment in time, showed the total energy bikers had generated throughout the concert.

## Research Methodology

### *Take the Stairs Campaign*

The core of our project was to measure elevator and stairs usage in a building over a period of time, then compare initial findings to after-campaign findings in order to determine whether our "Take the Stairs" campaign was effective.

### *Building Selection*

Before we could begin our research, we had to select a building in which our study could be effectively carried out. We determined five qualifications: high elevator usage, high foot traffic, short (as opposed to a high-rise building), visible and convenient stairwells, and stairwells located near elevators. These criteria made the Mathematical Sciences building a suitable choice for our project.

*Data Sources*

We originally intended for our data to come from three sources: elevator trip counters, kilowatt-hour meters installed in the elevators, and occupancy sensors in the east and west stairwells. Then, we analyzed the data to determine whether there was a significant increase in stairwell occupancy, and a significant decrease in elevator trips and total energy usage. We arranged for elevator trip readings to be taken and for occupancy sensors and kilowatt-hour meters to be installed; unfortunately, the kilowatt-hour meters we had installed were mistakenly removed during our campaign. As a result, we were unable to use kilowatt-hours as a measure of our results.

*Data Collection Phases*

Our data collection had three phases: a control phase, a two-week period during which the monitors were installed to gather baseline data; a campaign phase, another two-week period where we put up posters in the building and held up posters to encourage people to take the stairs; and a final two-week period where we collected data to compare to our baseline data. However, because data from the elevator trip counters and occupancy sensors were collected at different times than we had originally planned we resulted in two phases: the baseline period and the campaign period. The baseline period lasted approximately a month, from March 4$^{th}$ to April 7$^{th}$. The campaign period lasted about three weeks, from April 7$^{th}$ to April 22$^{nd}$.

*Earth Day Fair*

To spread awareness about energy efficiency, we set up an interactive trivia game in which visitors could select a question from three categories: renewable energy, household appliances, and miscellaneous. After they attempted to answer the question of their selection, we told them the correct answer and gave a short explanation. Participants received a sticker on their

passport, which could later be exchanged for free food and a raffle entry. In addition, if they answered questions correctly, we gave them cookies as an incentive.

*Ecochella*

We originally planned on recording watts generated every five minutes, but when the concert began we realized individual songs tended to last 2-4 minutes. Therefore we switched to recording from every five minutes to every two minutes for the rest of the concert. Because this year's wattage meter displayed total energy generated over the course of the concert instead of current energy generated, as was the case in Ecochella, 2013, we found the wattage per minute by taking the change in watts between every two-minute reading and divided by two.

In addition to recording the amount of energy generated and calculating the rate at which it was generated, we kept track of what was going on in the concert during each two-minute period, including bike malfunctions, power losses, and breaks between bands. After the concert, we calculated energy generation rates and created a graph that detailed changes in these rates throughout the concert.

**Results and Data Analysis**

*Stairs vs. Elevators Data*

Elevator data was obtained in three periods: the control period during 9$^{th}$ and 10$^{th}$ week of winter quarter, the campaign period during the 3$^{rd}$ and 4$^{th}$ week of spring quarter, and the weeks subsequent to the campaign. Due to logistical and technical issues with the data collection process, the data was instead collected over two periods in 35-day intervals. To supplement and verify the elevator trip count data, which counts the number of times the elevator doors have opened and closed, our team members made physical observations and collected data by hand.

Twice during the campaign period, we recorded over a one-hour-interval during peak times (11:00-12:00, 2:00-3:00) on weekdays (Tuesday and Friday). In peak times, the number of trips of elevator #220 is roughly 70 per hour, which is consistent with the elevator trip count of roughly 47-54 trips per hour over the day of elevator 220.

After analyzing the data for the elevator trips, we were unable to draw a consistent and conclusive evaluation of our campaign. While the total amount of elevator trips increased from 57850 to 76204 before and after the campaign, the increase can be attributed to the lack of traffic during spring break and the increase in traffic during the beginning of spring quarter. Thus, we recommend that more data on the elevator usage with more precise intervals be obtained for a more reliable conclusion. Moreover, more informative results could be obtained through analyzing the kilowatt-hour meter readings. A combination of the different data sources carried out over a longer data collection and campaign period could provide more comprehensive results.

Table 1: Elevator #220
Trip Counts

| Period | Date | Total trips | Days | Increment |
|---|---|---|---|---|
| Prior to Control period | 3/3/2014 | 93673 | 0 | 0 |
| End of Control Period | 4/1/2014 | 126926 | 29 | 33253 |
| Before Campaign | 4/7/2014 | 136163 | 6 | 9237 |
| End of Data collection | 5/12/2014 | 181608 | 35 | 45445 |

Table 2: Elevator #221
Trip Counts

| Period | Date | Total trips | Days | Increment |
|---|---|---|---|---|
| Prior to Control period | 3/3/2014 | 398953 | 0 | 0 |
| End of Control Period | 4/1/2014 | 414310 | 29 | 15357 |
| Before Campaign | 4/7/2014 | 414313 | 6 | 3 |
| End of Data collection | 5/12/2014 | 445072 | 35 | 30759 |

Table 3: Results

| Period | #220 | #221 | Total trips | Days |
|---|---|---|---|---|
| Before Campaign | 42490 | 15360 | 57850 | 35 |
| After Campaign | 45445 | 30759 | 76204 | 35 |

*Measuring stair usage through occupancy sensor*

The occupancy sensor data also provided inconclusive results. After compiling the data from the occupancy sensor, a limitation on the occupancy sensor resulted in only 15 days of data during the campaign period.

An occupancy sensor will light up for a number of times (represented by the number in the 'lit' column) to track movement in the stairwell. There will be a positive response (represented by the binary number 1) if the stairs are occupied and a negative response (represented by the binary number 0) if the stairs are unoccupied. After analyzing the percentage of stairwell occupancy across the two staircases and over the baseline and campaign periods, the results showed little change in the occupancy of the stairs in the two periods. In the west staircase, the probability of the staircase being occupied is 48.1% during the baseline period, and during the campaign period the probability is 48%. The difference between the two periods is negligible and can be attributed to natural variation. Similarly, the differences between the two periods in the East staircase (49.5% to 49.4%) also suggest there was not a significant change in behavior.

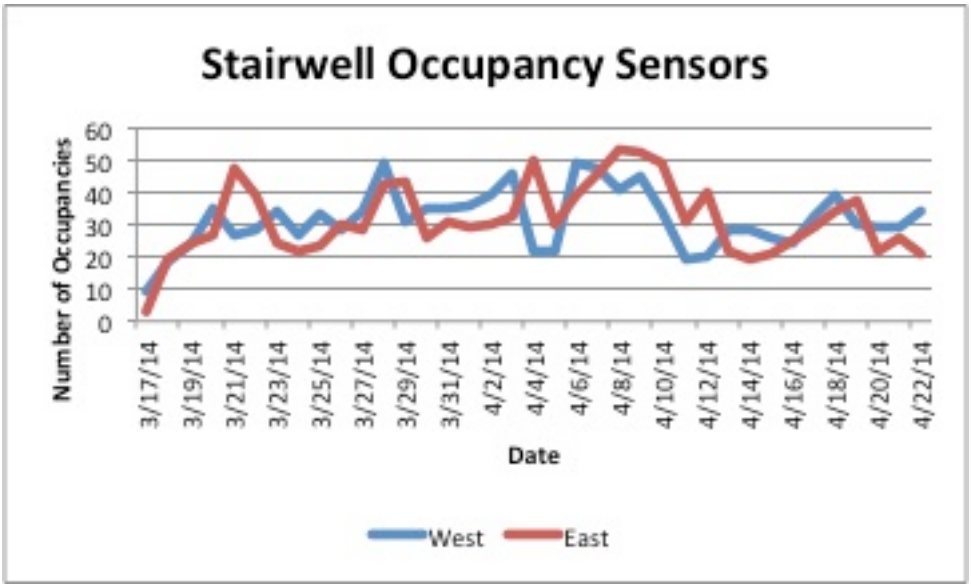


**Figure 1: Graph of Occupancy Sensors in the East and West Stairwells of the Mathematical Sciences Building**

Table 5: Stair occupancy sensor data

| **Math Sciences Stair Case #1 (West)** | | | | | | |
|---|---|---|---|---|---|---|
| **Periods** | **Days** | **Lit** | **No. of times of being occupied** | **Lit/Day** | **OCC/Day** | **%** |
| Baseline Period 3/4/14 1:48 pm to 4/7/14 8:20 am | 33.8 | 2253 | 1083 | 66.7 | 32.1 | 48.1 |
| Campaign Period 4/7/14 8:20 am to 4/22/14 8:06 pm | 15.5 | 1027 | 494 | 66.4 | 31.9 | 48.0 |

Table 6: Stairs occupancy sensor data

| **Math Sciences Stair Case #2 (East)** | | | | | | |
|---|---|---|---|---|---|---|
| **Periods** | **Days** | **Lit** | **No. of times of being occupied** | **Lit/Day** | **OCC/Day** | **%** |
| Baseline Period 3/4/14 1:48 pm to 4/7/14 8:20 am | 33.8 | 2234 | 1105 | 66.1 | 32.7 | 49.5 |
| Campaign Period 4/7/14 8:20 am to 4/22/14 8:06 pm | 15.5 | 969 | 478 | 62.6 | 30.9 | 49.4 |

**Key Findings**

While the short-term data may suggest otherwise, the observations made during our campaign have indicated the immense potential, particularly in energy savings, for our actions. During our campaign, we were able to influence a small but substantial portion of the students in the building to switch from taking the elevator to take the stairs. A profound long-term impact in the behavior of the UCLA community may be more observable with a prolonged campaign and data collection process. More specifically, we foresee that if we were to reduce the energy consumption of the elevators by 10%, a reduction of 4 kWh per day would be achieved. On the UCLA campus there are roughly 300 elevators (Belie). In Los Angeles, the average cost of one kWh is 17.8 cents (United States Department of Labor). If a 10% reduction in use is made in all the elevators on campus, UCLA can save a total of $79,000 and prevent 410 metric tons of carbon emissions.

UCLA Transportation has recently recognized the need for a similar campaign and behavioral change on the UCLA campus. Results of which can be found in Parking Structure 4.

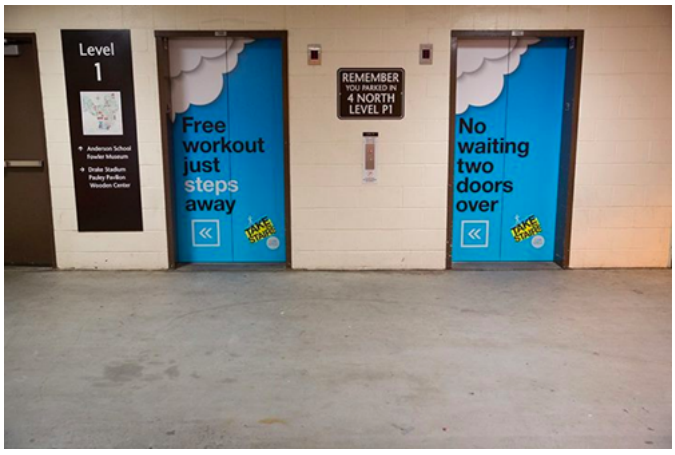


**Figure 2: UCLA Transportation's "Take the Stairs" Campaign in Parking Structure 4**

We encourage future teams to continue to delve into this area of research and collect more data to verify our observations.

## Recommendations

*"Take the Stairs" Campaign*

Throughout both quarters, communication proved to be a predominant issue. We highly recommend for future teams to get in touch with all external assistance as soon as possible. Since contacting through email proved to be ineffective at times, we recommend calling or setting up an appointment to meet in person to discuss details at hand. We believe this will be a quicker and more effective strategy in getting a response. As a team, we learned to quickly contact others if the previous contact had no response. Also, it is important to constantly monitor the data collected, as our occupancy sensors stopped logging and the kilowatt meters were removed before we had finished collecting data. To avoid this problem, we suggest periodically checking on the equipment to ensure it is working properly.

We also recommend starting the campaign during winter quarter rather than spring quarter, if possible. We suggest collecting baseline data prior to the campaign during winter quarter, and campaigning as much as possible during spring quarter. Two weeks for campaigning was not enough time to see a significant impact in the reduction of elevator usage. More campaigning time would provide more conclusive and accurate results. During the campaign period, it is vital to reach out to fellow Bruins and educate them about energy efficiency. In campaigning with posters near the elevators, we found it was essential to look approachable and be engaged with people passing by. The visuals were an integral part in catching student's attention, so we advise future groups to provide bright visual aids. We suggest keeping the poster messages short and to the point. Additionally, we recommend providing incentives to inspire them to take the stairs.

Furthermore, if future groups plan to continue this project, we suggest creating a friendly competition of students and faculty taking the stairs. Groups could log the flight of stairs taken by using recording devices and the student groups with the highest score can win a prize. This can further promote a culture of stair taking, promote a healthier lifestyle, and save energy.

*Earth Day Fair*

To further promote energy efficiency awareness on campus, we highly recommend future energy teams to create questionnaires or games at the Earth Day Fair. Visual aid proved to be helpful in capturing student's attention. Our activity showed to be an excellent way to reform people's way of thinking with respect to energy usage. In fact, our observations showed that many people were engaged and interested in learning about saving energy, especially when it came to cutting down on their bills. We recommend providing simple energy saving tips and encouraging the UCLA community to be environmentally conscious by passing out flyers, pamphlets, or eco-friendly incentives.

*Ecochella*

Ecochella once again proved to be successful in demonstrating that alternative energy can power large-scale events. If possible, we recommend future groups to continue research in similar activities that use alternative energy to power events, objects, etc. We recommend tabling at these events to increase further awareness about energy. At Ecochella, we recommend monitoring the energy generated and decibel level per song to see if there is a correlation. Because we logged these entries manually, we advise that future groups search for an application or device to track the energy usage. This would reduce human error, and allow future teams to help the concert-planners in other areas. Also, we recommend biking as a team and being a part of the movement to sustainable energy!

## Conclusion

Even though our quantitative data for the elevator and stairs usage demonstrated to have an inconclusive result, we believe our team has made a great effort to implement this project on campus. We believe that if this campaign continues next year, it can be more effective with the progress we have made this year. As for Ecochella, we believe it was a tremendous experience to be hands-on and see firsthand alternative energy generated. As for the Earth Day Fair, it was great project to inform the student body about energy efficiency. We were able to accomplish our goals by designing and implementing various campaigns that were geared towards saving energy usage and alternative energy resources.

As a team, we consider these projects to be a great success. Although we did not get the results we desired, we learned hands-on how to be flexible and collaborate with other groups and faculty. We believe this opportunity to work hands on has been a rewarding experience and fueled our interest in sustainability even further!

## Acknowledgements

We would like to thank our stakeholder, Sayros Yadgar, for helping us choose our research project, guiding us throughout the past two quarter, and meeting with us. In addition, we would like to thank Erik Ulstrup, an electrician at UCLA Facilities, for installing kWh meters in the elevators free of charge and Ronke Epps, the Chief Administrator Officer for the Mathematical Sciences building, for meeting with us and allowing us to put up posters in the Mathematical Sciences building. Lastly, we would like to thank all of the ESLP directors, and faculty for guiding us throughout these past two quarters, answering our questions, and giving us advice on ways to make our projects successful.

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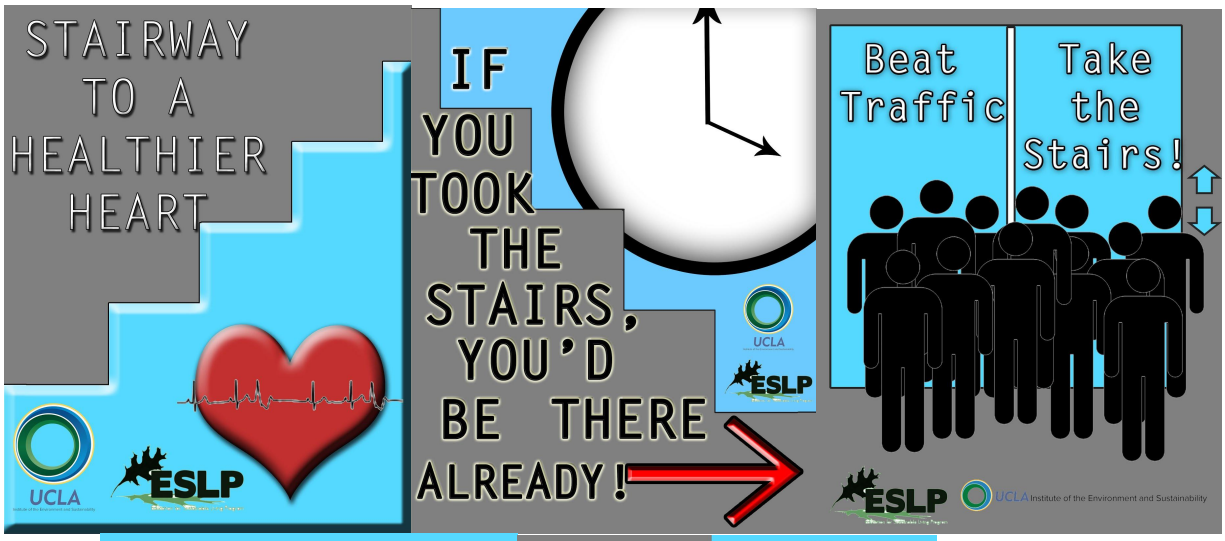
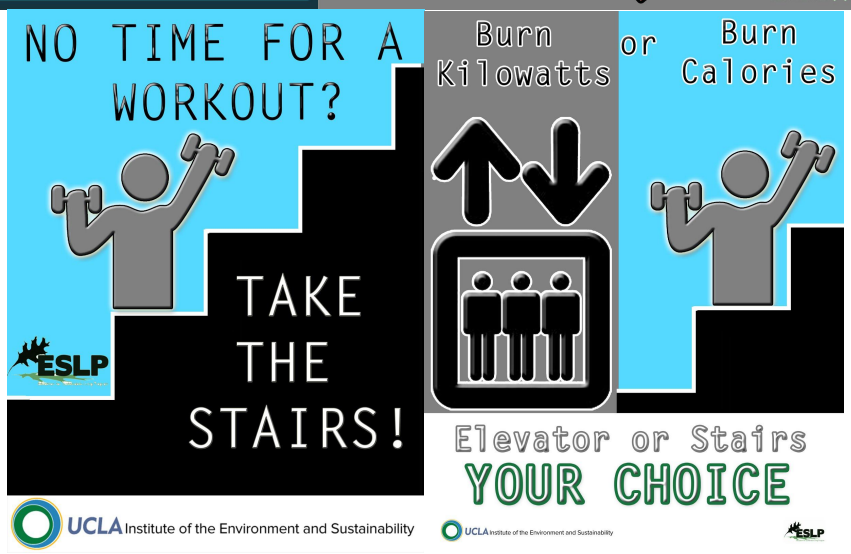
**Appendix**

*A. Posters and signage for "Take the Stairs" campaign*




*B. Earth Day Fair Trivia Questions*

# Earth Day Fair Trivia

## Renewable Energy

1. True or False: China built (roughly) one windmill an hour in 2009.

**Answer: True**

2. Which country is investing the most in renewable energy?

**Answer: China**

3. How many homes can a single wind turbine power?

a. 10 homes
b. 100 homes
c. 300 homes
d. 500 homes
e. 700 homes

**Answer: C. 300 homes**

4. Which renewable energy sector has experienced the largest job growth?

a. Bioenergy
b. Solar power
c. Wind power
d. Geothermal

**Answer: A. Bioenergy**

5. True or False: It is possible to generate electricity from grass.

**Answer: True**
Grass is a fast-growing, readily available source of biomass. It can be burned to generate heat and electricity.

6. True/ False: The average US taxpayer pays almost 100 times as much in subsidies for fossil fuels as he does for solar energy.

**Answer: True**

7. Where is the world's largest solar power plant?

A. Mojave Desert
B. Tropics
C. Colorado Plateau
D. Forty Mile Desert

**Answer: A. Mojave Desert**
The Ivanpah Solar Electric Generating System in California's Mojave Desert is currently the world's largest solar power plant.

## Household Appliances

1. About how many appliances does the average household leave plugged in around the clock?

a. 5
b. 20
c. 40
d. 60

**Answer: c. about 40 (Lawrence Berkeley National Laboratory)**

2. Name some of the appliances you leave plugged in around the house that could be unplugged when not in use to save energy.

**Examples: TVs, video game consoles, laptops, DVD players, cell phone chargers**
http://www.dosomething.org/tipsandtools/top-5-energy-sucking-vampire-appliances

3. True or False: A full freezer consumes less energy than an empty one.

**Answer: True**
In a full freezer, there is less room for warm air. Items already in the freezer help cool warm air down. This decreases the amount of energy the freezer needs to expend to keep its interior cool.

4. How much money does the average American household waste per year powering appliances that are not in use?

a. $50
b. $100
c. $500

**Answer: b. $100**

5. How much does the United States as a whole spend on powering appliances not in use annually?

a. $1 million
b. $10 million
c. $10 billion
d. over $10 billion

**Answer: d. over $10 billion**
https://www.energystar.gov/index.cfm?c=about.vampires

6. How much energy could you potentially save annually if you let your clothes air dry instead of using the dryer whenever possible?

a. 15 kilowatt-hours (kWh)
b. 125 kWh
c. 225 kWh
d. 500 kWh

**Answer: c. 225 kWh or more**
http://energy.gov/energysaver/articles/estimating-appliance-and-home-electronic-energy-use

7. How much money could you save annually by washing your clothes with cold water instead of warm or hot water?

a. $10
b. $50
c. $100

d. $250

**Answer: d. $250**
On average, washing your clothes with cold water instead of hot water will save you 64 cents each load, equivalent of $250 per year, and a great amount of energy as well!
http://michaelbluejay.com/electricity/laundry.html

8. Which of the following are ways to lower refrigerator energy consumption?

A. Keep the fridge full
B. Let food cool down before putting it in the fridge
C. Don't open the fridge unnecessarily
D. Place the refrigerator away from heat sources, near but not against a wall
E. Clean the dust back of the fridge regularly
F. All of the Above

**Answer: F. All of the Above**
All of these things reduce the amount of work the refrigerator has to do in order to maintain optimal temperature.

9. What is the ideal temperature setting (in degrees Fahrenheit) for your refrigerator?

a. 0
b. 32
c. 40
d. 60

**Answer: c. 40 degrees Fahrenheit**

10. What is the ideal temperature setting for your freezer?

a. 0
b. 32
c. 40
d. 60

**Answer: about 0 degrees Fahrenheit**

## Miscellaneous

1. What benefits do trees planted near houses provide?

a. shade during the summer
b. barrier against winter winds
c. reduced soil erosion
d. cleaner air
e. all of the above

> **Answer: e. all of the above**
> Trees are awesome.
> Source:
> http://www.alliantenergykids.com/EnergyandTheEnvironment/RenewableEnergy/022403

2. Why is it not good for the environment to buy bottled water?

> **Answer:** A typical one liter plastic bottle requires 3.4 mega joules of energy and 3 liters of water to produce, releasing 3 kg of carbon dioxide into the atmosphere. In addition, tap water is actually more heavily regulated than bottled water. Get reusable bottles!
> http://pacinst.org/publication/bottled-water-and-energy-a-fact-sheet/

3. How much more energy does it take to produce one calorie of protein from beef compared to one calorie of protein from soybeans?

a. same amount of energy for both
b. 2 times more
c. 17 times more
d. 27 times more

> **Answer: d. 27 times more**
> Eat tofu.
> http://michaelbluejay.com/veg/environment.html

*C. Ecochella Graph and Data Table*

*Ecochella Data*

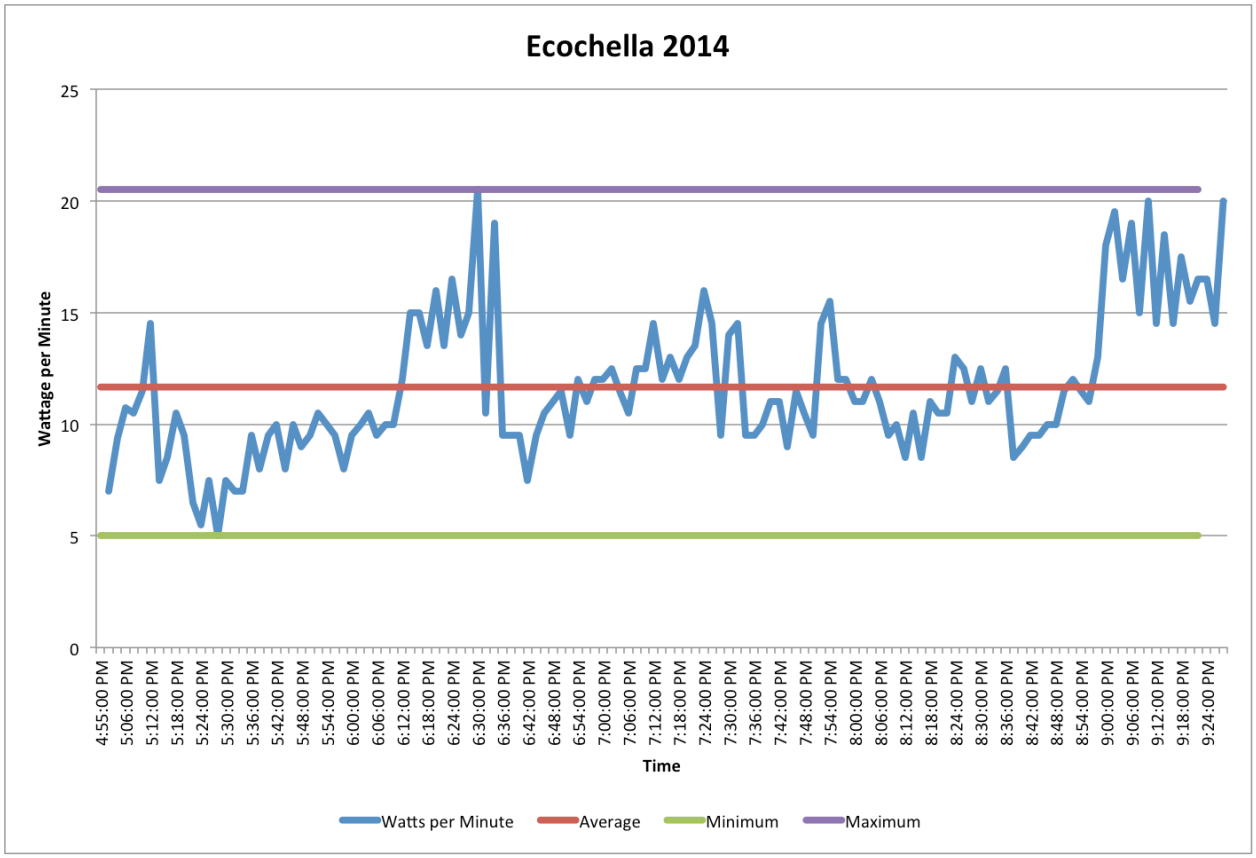



**Figure 3: Wattage generated per Minute at Ecochella 2014**

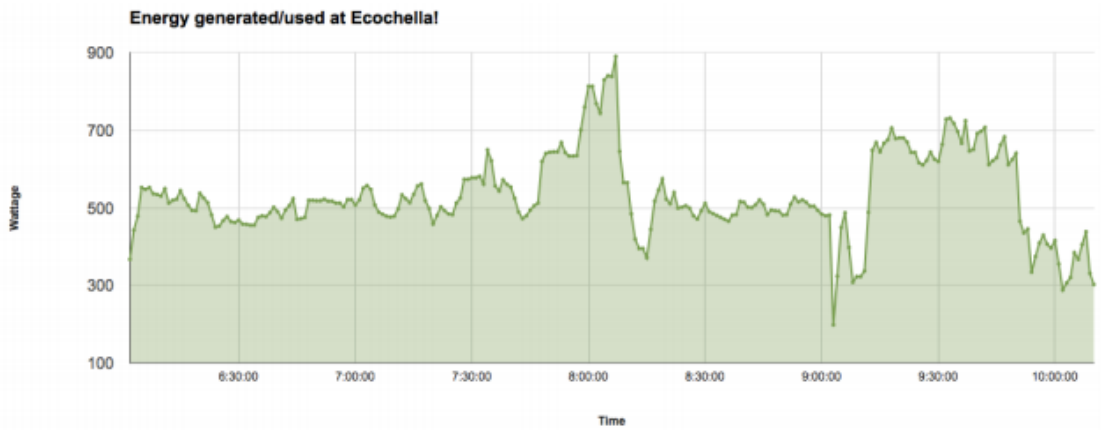



**Figure 4: Wattage Generated per Minute at Ecochella 2013**

Table 7: Ecochella Data

| Time | Wattage | Watts per Minute | Notes |
|---|---|---|---|
| 4:50:00 PM | 213 | | first band (Like Damn), first song |
| 4:55:00 PM | 248 | 7 | one bike broke for about a minute, was fixed quickly |
| 5:00:00 PM | 295 | 9.4 | Like Damn, second song |
| 5:04:00 PM | 338 | 10.75 | Like Damn, third song |
| 5:06:00 PM | 359 | 10.5 | Like Damn, fourth song |
| 5:08:00 PM | 382 | 11.5 | not quite sure when the fourth song ended and the fifth began |
| 5:10:00 PM | 411 | 14.5 | |
| 5:12:00 PM | 426 | 7.5 | Like Damn, sixth song |
| 5:14:00 PM | 443 | 8.5 | |
| 5:16:00 PM | 464 | 10.5 | |
| 5:18:00 PM | 483 | 9.5 | break between bands |
| 5:20:00 PM | 496 | 6.5 | break between bands |
| 5:22:00 PM | 507 | 5.5 | break between bands |
| 5:24:00 PM | 522 | 7.5 | break between bands |
| 5:26:00 PM | 532 | 5 | break between bands |
| 5:28:00 PM | 547 | 7.5 | break between bands |
| 5:30:00 PM | 561 | 7 | break between bands |
| 5:32:00 PM | 575 | 7 | Naomi and the Bandits, first song |
| 5:34:00 PM | 594 | 9.5 | |
| 5:36:00 PM | 610 | 8 | Naomi and the Bandits, second song |
| 5:38:00 PM | 629 | 9.5 | |
| 5:40:00 PM | 649 | 10 | Naomi and the Bandits, third song |
| 5:42:00 PM | 665 | 8 | Naomi and the Bandits, fourth song |
| 5:44:00 PM | 685 | 10 | |
| 5:46:00 PM | 703 | 9 | break |
| 5:48:00 PM | 722 | 9.5 | Naomi and the Bandits, fifth song |
| 5:50:00 PM | 743 | 10.5 | Naomi and the Bandits, sixth song |
| 5:52:00 PM | 763 | 10 | break between bands |
| 5:54:00 PM | 782 | 9.5 | break between bands |
| 5:56:00 PM | 798 | 8 | break between bands |
| 5:58:00 PM | 817 | 9.5 | break between bands |
| 6:00:00 PM | 837 | 10 | break between bands |
| 6:02:00 PM | 858 | 10.5 | sound check |
| 6:04:00 PM | 877 | 9.5 | sound check (lost power) :( |
| 6:06:00 PM | 897 | 10 | lost power still (due to a lot of instruments plugged in) |
| 6:08:00 PM | 917 | 10 | first level of green, power back |
| 6:10:00 PM | 941 | 12 | first song the end of summer band plays |
| 6:12:00 PM | 971 | 15 | first song continues |
| 6:14:00 PM | 1001 | 15 | red level, first song |
| 6:16:00 PM | 1028 | 13.5 | second song the end of summer |
| 6:18:00 PM | 1060 | 16 | break time |
| 6:20:00 PM | 1087 | 13.5 | third song |
| 6:22:00 PM | 1120 | 16.5 | third song continues |

| | | | |
|---|---|---|---|
| 6:24:00 PM | 1148 | 14 | break time, fourth song then plays |
| 6:26:00 PM | 1178 | 15 | fourth song still plays |
| 6:28:00 PM | 1219 | 20.5 | fourth song still plays |
| 6:30:00 PM | 1240 | 10.5 | break time, fifth song plays |
| 6:32:00 PM | 1278 | 19 | fifth song plays |
| 6:34:00 PM | 1297 | 9.5 | in between bands |
| 6:36:00 PM | 1316 | 9.5 | |
| 6:38:00 PM | 1335 | 9.5 | |
| 6:40:00 PM | 1350 | 7.5 | |
| 6:42:00 PM | 1369 | 9.5 | sound check |
| 6:44:00 PM | 1390 | 10.5 | band starts |
| 6:46:00 PM | 1412 | 11 | |
| 6:48:00 PM | 1435 | 11.5 | |
| 6:50:00 PM | 1454 | 9.5 | Max capacity for majority of time |
| 6:52:00 PM | 1478 | 12 | in between bands |
| 6:54:00 PM | 1500 | 11 | sound check |
| 6:56:00 PM | 1524 | 12 | |
| 6:58:00 PM | 1548 | 12 | |
| 7:00:00 PM | 1573 | 12.5 | |
| 7:02:00 PM | 1596 | 11.5 | |
| 7:04:00 PM | 1617 | 10.5 | First song |
| 7:06:00 PM | 1642 | 12.5 | |
| 7:08:00 PM | 1667 | 12.5 | Second song |
| 7:10:00 PM | 1696 | 14.5 | Third song |
| 7:12:00 PM | 1720 | 12 | |
| 7:14:00 PM | 1746 | 13 | |
| 7:16:00 PM | 1770 | 12 | Fourth song |
| 7:18:00 PM | 1796 | 13 | |
| 7:20:00 PM | 1823 | 13.5 | Fifth song |
| 7:22:00 PM | 1855 | 16 | |
| 7:24:00 PM | 1884 | 14.5 | sixth song |
| 7:26:00 PM | 1903 | 9.5 | |
| 7:28:00 PM | 1931 | 14 | switching bands |
| 7:30:00 PM | 1960 | 14.5 | |
| 7:32:00 PM | 1979 | 9.5 | |
| 7:34:00 PM | 1998 | 9.5 | |
| 7:36:00 PM | 2018 | 10 | |
| 7:38:00 PM | 2040 | 11 | |
| 7:40:00 PM | 2062 | 11 | The Ubiquitous Love Tribe, song 1 |
| 7:42:00 PM | 2080 | 9 | |
| 7:44:00 PM | 2103 | 11.5 | |
| 7:46:00 PM | 2124 | 10.5 | technical difficulties |
| 7:48:00 PM | 2143 | 9.5 | music starts again, song 2 |
| 7:50:00 PM | 2172 | 14.5 | |
| 7:52:00 PM | 2203 | 15.5 | song 3 |
| 7:54:00 PM | 2227 | 12 | |
| 7:56:00 PM | 2251 | 12 | song 4 |

| | | | |
|---|---|---|---|
| 7:58:00 PM | 2273 | 11 | |
| 8:00:00 PM | 2295 | 11 | |
| 8:02:00 PM | 2319 | 12 | |
| 8:04:00 PM | 2341 | 11 | band done |
| 8:06:00 PM | 2360 | 9.5 | raffle |
| 8:08:00 PM | 2380 | 10 | e3 announcements/shout-outs |
| 8:10:00 PM | 2397 | 8.5 | raffle |
| 8:12:00 PM | 2418 | 10.5 | |
| 8:14:00 PM | 2435 | 8.5 | sound check |
| 8:16:00 PM | 2457 | 11 | sound check |
| 8:18:00 PM | 2478 | 10.5 | sound check |
| 8:20:00 PM | 2499 | 10.5 | attic empire 1st song |
| 8:22:00 PM | 2525 | 13 | 1st song |
| 8:24:00 PM | 2550 | 12.5 | 2nd song |
| 8:26:00 PM | 2572 | 11 | 2nd song |
| 8:28:00 PM | 2597 | 12.5 | 2nd song |
| 8:30:00 PM | 2619 | 11 | 3rd song |
| 8:32:00 PM | 2642 | 11.5 | 3rd song |
| 8:34:00 PM | 2667 | 12.5 | 3rd song |
| 8:36:00 PM | 2684 | 8.5 | in between bands |
| 8:38:00 PM | 2702 | 9 | |
| 8:40:00 PM | 2721 | 9.5 | |
| 8:42:00 PM | 2740 | 9.5 | |
| 8:44:00 PM | 2760 | 10 | |
| 8:46:00 PM | 2780 | 10 | |
| 8:48:00 PM | 2803 | 11.5 | |
| 8:50:00 PM | 2827 | 12 | sound check Papa |
| 8:52:00 PM | 2850 | 11.5 | |
| 8:54:00 PM | 2872 | 11 | song started then cut off |
| 8:56:00 PM | 2898 | 13 | song starts again |
| 8:58:00 PM | 2934 | 18 | |
| 9:00:00 PM | 2973 | 19.5 | song ends, next song starts |
| 9:02:00 PM | 3006 | 16.5 | |
| 9:04:00 PM | 3044 | 19 | song ends, next song starts |
| 9:06:00 PM | 3074 | 15 | |
| 9:08:00 PM | 3114 | 20 | song ends, next song starts |
| 9:10:00 PM | 3143 | 14.5 | |
| 9:12:00 PM | 3180 | 18.5 | |
| 9:14:00 PM | 3209 | 14.5 | song starts |
| 9:16:00 PM | 3244 | 17.5 | |
| 9:18:00 PM | 3275 | 15.5 | song starts |
| 9:20:00 PM | 3308 | 16.5 | |
| 9:22:00 PM | 3341 | 16.5 | |
| 9:24:00 PM | 3370 | 14.5 | song starts |
| 9:26:00 PM | 3410 | 20 | |
| | | | |
| | **MAX** | 20.5 | |

| | | | |
|---|---|---|---|
| | **MIN** | 5 | |
| | **AVERAGE** | 11.66 | |