

Sustainability Counts! Energy Challenge Higher Education Version

We invite college and university math faculty and their students from across the nation to take part in the Sustainability Counts! Energy Challenge. Students will learn the mathematics of energy use and then develop and implement a plan to reduce energy use on their campus. The implementation period is flexible depending on each campus's situation and can range from one day to several weeks. Students will estimate how much energy was saved, either by comparing energy use to a baseline value or by calculating the savings based on their mathematical model. In carrying out the Energy Challenge, we encourage participants to partner with their institution's facilities staff who have a wealth of knowledge on these issues.

Participants will submit their results to our [national database](#) where we will track how much energy the Sustainability Counts Energy Challenge saves nationwide. While each of us as individuals have a role to play in energy conservation, to make a significant impact we have to work together!

Those of us on the Advisory Committee for Math Awareness Month 2013 have found that having an official "title" has made it easier for us to take initiative and organize activities. So we hereby deputize you as a **Math Awareness Month Sustainability Counts! Coordinator** for your institution. Congratulations!

Course level: The mathematics involved in modeling energy use is not complicated, basically involving algebra. So the Energy Challenge can be undertaken by any college or university math class that wants to connect mathematics to an important real world issue – sustainability. The Energy Challenge would be particularly well suited for a quantitative literacy or a math modeling course.

The Higher Ed Energy Challenge is in many ways very similar to the K-12 Energy Challenge so take a look at those instructions.

For the most part, we expect participants to focus their Energy Challenge on electrically energy use as this is the easiest to measure. While it may not be feasible to measure other types of energy savings, one can certainly include all types of energy saving efforts in one's initiative.

Step 1: Determine the Focus. There are several options for carrying out the Higher Ed Energy Challenge. One could develop and implement an energy plan for one (or several) dormitories or for an academic building or for some mixture of the two. For a commuter institution without dormitories, one would focus on an academic building.

Step 2: The Mathematics Involved. The students will learn about the energy use of various electrical devices in the buildings. For each device that is in the building or dormitory being evaluated, find out how much power (in units of watts or kilowatts) the device uses and then estimate how many hours the device is running (per day, per month, per year) to determine the cost of usage. Also determine the carbon footprint associated with that amount of electrical energy generation. Spreadsheets are a great way to keep track of these calculation. It often works well if each student (or perhaps a team of two students) becomes

the class expert on a particular device and takes responsibility for learning about and carrying out all the calculations related to that device.

The following materials found in the Energy Challenge section of the Sustainability Counts webpage provide useful information about energy usage levels:

- Plug Load unit from the National Energy Education Development Project ([NEED](#))
- Conscientious Energy Consumer unit from the Alliance to Save Energy ([ASE](#)).
- Plug Load and Phantom Load pre-made spreadsheets from NEED.

To make the lesson more challenging, you could require the students to find the wattage ratings for different device themselves rather than using the values from the above units. Another and perhaps more engaging approach is to use a plug-in watt meter to measure the actual power being used by the device. Maybe your science or facilities department has one your students can use. One can also guide the students to develop their own spreadsheets.

A big component of electrical energy use is lighting. Consider inviting a facilities professional to talk with the class about the different types and efficiencies of fluorescent bulbs used in academic buildings (T12, T8, T5) and teaching the students to recognize the different types.

Step 3: Make a Plan. Students will develop an energy reduction plan based on their findings in Step 2 and determine where and for how long to implement it. Turning off lights is one way to save energy. Some schools have a “lights out” day or hour in which classrooms try to keep their lights turned out and just use natural light. Another idea is to turn off the non-emergency lights in the hallways between classes or wait until almost the start of school to turn those lights on. See the Alliance to Save Energy’s *Energy Saving Tips for Schools* at the end of this document. As part of the plan, the students should predict how much energy they expect to save and justify their prediction using the mathematics of Step 2.

The plan could focus on saving energy in an academic building such as the math or science building. In such a case, the class’ plan could include involving faculty and other students in the effort. If the focus is on saving energy in one or several dorms, the plan could include recruiting other students to take part.

Step 4: Implement the Plan. In conjunction with implementation, the students can work to create “buzz” about the event by publicizing the initiative on campus, getting the school paper to write about, even reaching out to local news outlets. The students contact the public information office which may want to play up the initiative on the institution’s website. The Sustainability Counts! [publicity packet](#) includes a sample press release and invitation letter.

Be sure to [register](#) as a Sustainability Counts! participant; the national organization can help you get publicity. And when you register, we will mail you up to five free copies of the [Mathematics of Sustainability poster](#).

Step 5: Determine the Energy Savings. There are a variety of ways to do this.

- a. Establish a baseline of the standard energy use in the academic building or dorm. This could involve working with the facilities office to determine the monthly energy use in the building the previous year at the same time and then estimating a daily or weekly energy usage. Then determine the energy usage during the Energy Challenge period and estimate the savings.

This approach could face several obstacles. Not every building at an institution has its own electrical meter. So determining the baseline and event savings for the building might require some proportional estimating. In some cases, the institution might only get a monthly energy bill. If the Energy Challenge lasted less than a month, it could be difficult to decide the savings.

- b. Energy smart meter. If your institution has an energy smart meter that allows you to see energy use in real time, then use the meter to see the actual drops in electricity consumption that are being caused by the various energy conservation actions. For example, if one turns the non-emergency lights off in the hallways, then the smart meter should show a noticeable dip in electrical usage at that time.
- c. Estimating Energy Savings. If you are not able to get an actual measurement of energy savings, estimate the savings using the data on device power and by keeping track of the amount of time by which you reduce device usage. In the case of a dormitory, each student could keep an Energy Challenge journal spreadsheet in which they record their energy savings actions. The class would then combine all the individual savings to get the total.

Step 6: Post Event Debrief. Examine with the students the energy savings that were achieved. Compare these numbers with the savings your mathematical model had predicted. Discuss reasons for any differences. Think about ways that one might revise the mathematical model to make more accurate predictions in the future.

Your students will have now engaged in a full cycle of mathematical modeling. Creating a model (i.e. gathering the data and performing the initial calculations), testing the model (ie. implementing the energy reduction plan and comparing predicted outcomes with actual outcomes), and revising the model based on the findings.

Have the students discuss which components of their energy reduction plan it would be feasible to implement on a regular basis year round. Have them estimate how much energy and money could be saved over the course of a year.

Step 7: Celebrate your Students' Success! Organize some type of post event celebration that highlights the students' achievement in using their mathematical skills to green the institution, help save money and reduce the carbon footprint. Students could present their findings to a student government or administrator group with recommendations for future energy conservation efforts.

Step 8: Send in your Energy Savings Results. Send your results to the Energy Challenge [national database](#) where we will track how much energy students nationwide have saved. By filling in the requested information, you will also receive a Certificate of Participation.

Step 8: Plan for the Future.

There are a wide range of organizations and initiatives for institutions of higher education involving sustainability including The Association for the Advancement of Sustainability in Higher Education ([AASHE](#)).

The Alliance to Save Energy's [PowerSave Campus Program](#) is a student-driven energy efficiency education program that promotes careers in the field, generates actual energy savings, increases awareness of the importance of energy efficiency, and encourages academic infusion of sustainability concepts. An exciting component of the PowerSave Campus Program is the [Campus Conservation Nationals](#) in which colleges and universities across the country compete to see who can save the most energy.

Institutionalize your campus' energy conservation efforts by becoming part of the PowerSave Campus Program and compete annually in their competition (held between February and April).

As a mathematics educator, make sure that the students taking part can do the math of energy conservation and hence can determine from mathematical modeling which conservation actions will be most impactful. Use other lessons that connect math with sustainability (see the [Model Lessons Section](#) of the Sustainability Counts website or the [Related Resources](#) page).



Energy Saving Tips for Schools

Lighting

1. Turn off lights when not in use—lighting accounts for nearly 50% of the electric bill in most schools. There's no reason to leave lights on if a room is empty for more than one minute. (And, yes, this applies to the new energy-efficient fluorescent lights.)
 - Form a student energy patrol to ensure lights are out when rooms are empty (check classrooms, the cafeteria, the auditorium, etc.).
 - Have students make signs and stickers to remind people to turn off the lights when they leave a room.
 - Put light switches where people can find and operate them.
2. Remove unneeded light fixtures near windows, especially in unused corners or along banks of windows.
 - Have students conduct an experiment in classrooms by turning off selected banks of lights and surveying occupancy comfort at different lighting levels (often, occupants prefer working under natural light).
3. Use energy efficient compact fluorescent light bulbs (CFLs) and light-emitting diode (LED) bulbs.
 - Have students calculate the energy savings achieved by:
 - Replacing incandescent light bulbs with CFLs
 - Changing incandescent lights in Exit Signs to light-emitting diode (LED) bulbs

Heating & Cooling

1. Save on energy costs without sacrificing comfort. It's expensive to heat and cool school buildings, but indoor temperatures must be comfortable so teachers can concentrate on teaching and kids can concentrate on learning. A rule of thumb: Consider setting thermostats at 68 degrees for heating and 78 degrees for cooling. Using fans can make people feel degrees cooler, at much less cost than air conditioning.
2. Where classrooms or other areas are uncomfortably cold or drafty, find out why and fix the problem. Custodians, teachers, and students should work together to increase building comfort.
 - Don't block the airflow around vents. Keep bookcases and other bulky items away from the heating and cooling units so they don't block and/or absorb the warm (or cool) air that should be coming into the room.
 - Install programmable thermostats in areas like the cafeteria to minimize operating hours of the heating and cooling systems during low occupancy periods.
 - Turn down heat in the hallways. And—keep classroom doors closed. Otherwise, the heat runs down the hall and outside—where it is wasted to the outdoors.
 - Clean furnace filters regularly.

3. Stop leaks!! Look for simple draft beating strategies.
 - Have students determine areas of energy loss by using “draftmeters” made from plastic wrap and pencils to study where drafts are coming in.
 - Avoid infiltration in conditioned spaces.
 - Have students help replace insulation and stuff energy loss “holes” through innovative measures, such as making translucent window quilts to hang in classrooms and “insulation snakes” to put at the bottom of doors and windows.
 - Work with facility staff to install permanent weather stripping, caulking, and insulation.

Computers

1. If your school computers have power-management features, make sure controls are set so they will go into the “sleep” mode when not in active use. (Screen savers don’t save energy—only the sleep mode does.)
2. Students should turn off monitors that will not be used for the next class period. All computer equipment should be turned off at the end of the day and on weekends, unless your network technicians specifically instruct otherwise.
 - Form a student energy patrol to make sure monitors are off when computers are not in use and to turn computers off at the end of the day.
3. Is your school purchasing new equipment? Save 50% on energy costs by using Energy Star computers, monitors, printers, fax machines, copiers and other equipment. (Visit www.energystar.gov for more information.) Have students calculate potential savings from the use of Energy Star equipment and present the results to school administrators. If your school purchases the equipment, make sure the Energy Star features are enabled.

Appliances

1. Maintain appliances and replace old appliances.
 - Have students use a watt meter to study how much electricity a device uses. This is useful in determining which appliances are outdated and less efficient.
 - Have students conduct a survey of the number of appliances in each classroom and encourage teachers to take away unneeded appliances.
2. Clean refrigerator coils regularly.

Involve the Whole School

1. Get the entire school involved. Energy savings add up when the entire school joins together in conservation efforts. Schools with effective conservation programs have reported reductions of as much as 25% in utility bills.
2. Publicize energy costs and savings. When people know how much it costs to power their school, they can see why it’s worth some extra effort to avoid waste.

Involve the Whole District

See if your district administrators would be willing to return a percentage of the dollars saved from your school's no-cost energy efficiency changes

<http://www.ase.org/resources/energy-saving-tips-schools>