**Introduction to Sustainability**

**Action to Enhance Sustainability**

**Notes on Content of Final Report**

Your final report should include the three Parts outlined below. There is no minimum page requirement, but it should address the three parts in some detail. It should be a stand-alone document so that any person who reads it will know why you conducted your action, what you actually did, and what the wider implications of your action.

**Part I**. D**escription of action**, including an explanation of the relevance of what you are doing for sustaining earth’s resources.

**Part II. Detailed log of what you actually did** [for example, as shown below for a recycling action]. The more you document and quantify your actions, the better your chances for obtaining a higher grade. You are required to provide the following itemized documentation: (1) the action conducted; (2) the quantification factor associated with your action (for example, pounds of paper and number of bottles recycled, or number of miles you walked instead or drove; or number of light bulbs you replaced with efficient CFL bulbs, etc.); (3) the date your action occurred, and the hours you spent on your action [you need a cumulative 10 total hours for maximum credit]. Some actions will be more quantifiable in this regard than others; for example, if you are growing an organic garden it may be harder to put numbers on your actions than if you are recycling. I will take such contingencies into account when grading your papers. If you need help on structuring and quantifying your log, please ask me for assistance.

**Sample Log**

**Example for Recycling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Action item** | **Quantities/other notes** | **Date** | **Hours spent** |
| 1. Sorted trash for paper, plastic, and glass |  | 9/18 | 0.15 |
| 2. Dropped off collected sorted materials to CF Recycling Center | Pounds of paper; number of plastic bottles/glass | 9/21 | 0.30 |
| 3. Repeat of Item 1. |  | 9/25 | 0.15 |
| 4. Repeat of Item 2. | Pounds of paper; number of plastic/glass bottles | 9/28 | 0.30 |
| Etc. |  |  |  |
| Etc. |  |  |  |
| 15. Did research to determine benefits of recycling, including facts about energy/greenhouse gases saved. |  | 10/17 | 2.50 |
| 16. Cumulative totals | Pounds; number of bottles, etc. |  | 10.0 |

**Note: be sure to add a row showing cumulative amounts in second and fourth columns.**

**Part III. Conclusions**: Tell what you learned/achieved. **Be sure to reference any sources you used in your work.** To maximize your grade, try to include some interesting factors into your action that enlarge the significance of what you have done. By way of illustration, the following are three examples of what I mean by expanding the significance of your findings:

Example 1: Recycling.

When you recycle a material such as an aluminum or plastic bottle, you almost always save energy and prevent greenhouse gas emissions, because remaking new materials from recycled materials requires less energy and less material inputs than if the new materials are made from scratch from virgin raw materials. A web search will uncover a huge amount of literature about how much energy is saved for a particular kind of recycled material, or how much greenhouse gas emission is prevented. Thus you could express your actions not only in terms of how many hours you worked, or how many pounds of stuff you recycled, but also how much energy you saved and how much greenhouse gas emissions you avoided. You may find the table in the Appendix helpful for quantifying energy and CO2 savings from recycling. Example 1 in the Appendix illustrates a sample calculation for recycling.

Example 2: Reducing your driving miles.

When you walk or ride your bike as an alternative to driving, you reduce your consumption of gasoline. In this case, remember there are multiple other benefits as well. You also improve your health, reduce your stress, perhaps spend more quality time with friends [if they join you on your walk], etc. Think about multiple benefits derived from your actions and include them in your conclusions. Also calculate how much CO2 you are saving by estimating how many gallons of gasoline you saved. Every gallon of gasoline not burned saves about 20 pounds of CO2. Perhaps you could even calculate how many calories your body burned when you walked or cycled in place of driving. Think expansively and write down your ideas. Example 2 in the Appendix illustrates a sample calculation for walking instead of driving.

Example 3: Reducing electricity in your home.

Some great ways to reduce your electricity use are to turn off lights when leaving the room, unplug appliances when not in use, and replace standard incandescent bulbs with compact fluorescent lights (CFLs). When you turn off a light or use a CFL, you save kilowatt hours (kWh) – this translates directly into savings in money, energy, and CO2 emissions. In your final report you can list and quantify these benefits. See Example 3 in the Appendix for a sample calculation with regard to this action.

These are only three examples. If your project involves some other type of action and you need some help on how to expand the significance of your findings, please do not hesitate to contact me so we can brain storm some ideas. As a first step, begin your action early; working on the expansive implications of your actions can evolve as you develop the narrative for your final report.

**Timeline for submissions**

* September 8: Draft outline of Action to Enhance Sustainability. By this time you have decided on a course of action and have developed an outline on how you wish to proceed. Turning in your outline will allow me to review your plan, gauge its quality and feasibility, and provide suggestions for improvement. This is an important step in order to ensure you are on the right track with you plan and can begin to implement it. You are welcome to submit your outline before the due date if you want to get started with your action as early as possible.
* September 22: Finalized outline of Action to Enhance Sustainability. Based on my comments on your draft plan you will turn in your finalized plan, structuring it according to Parts I, II, and III discussed above.

* November 15: Provisional final report on Action to Enhance Sustainability (optional). If you wish, you may turn in for my review, a provisional report on your work to enhance sustainability at this date. You may do so, even if you are still in the process of completing your action. You can view this report either as a final submission, or as a review draft. The advantage for you to turn in the provisional report is the feedback I will provide on the quality of your work to date, indicating ways that you can improve your action plan (and your grade), if necessary.
* November 29: Final report on Action to Enhance Sustainability. On this date you will turn in the final report, incorporating any suggested revisions I made to your provisional report. You will also give a brief presentation to the class on your action.

**Appendix**

Energy and CO2 Savings for Some Common Recycled Materials

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Product (a) | Unit measured(b) | Weight of unit  (grams) (c) | Energy savings  (kWh per unit) | CO2 savings  (pounds per unit) |
| Aluminum cans | One 12 fl. oz. can | 14 | 0.94 | 0.47 |
| Steel (tin) cans | One 14.5 dry oz. can | 57 | 0.37 | 0.25 |
| Plastic (PET) bottles | One 20 fl**.** oz. bottle | 24 | 0.41 | 0.09 |
| Plastic (PET) bottles | One 1-liter bottle | 34 | 0.58 | 0.13 |
| Plastic (PET) bottles | One 2-liter bottle | 48 | 0.82 | 0.18 |
| Plastic (HDPE) milk jug | One gallon | 60 | 0.98 | 0.20 |
| Glass wine bottle | One 0.75-liter bottle | 650 | 0.45 | 0.46 |
| Cardboard | One pound | 454 | 2.26 | 3.43 |
| Mixed paper | One pound | 454 | 3.36 | 3.87 |

Notes: (a) “PET” plastic bottles are made from “polyethylene terephthalate;” they are the most common kind of bottle for water and carbonated beverages. “HDPE” plastic bottles are made from “high density polyethylene;” they are most commonly used for noncarbonated beverages and milk jugs.

(b) The sizes of beverage cans and bottles given in this column refer to the volumes of liquid they hold. The labels of smaller containers give volumes in “fluid ounces” (fl. oz.) - there are 32 fl. oz. in a quart. Larger beverage containers give volumes in “liters”, quarts, or gallons. One liter is approximately the same volume as one quart. “Tin” food cans are actually mostly made of steel. In this row the size of the tin can refers to the weight of food it contains. The labels usually give the weights in “dry ounces” (dry oz.) - there are 16 dry oz. in one pound. A standard tin can holds 14.5 dry oz. of food.

(c) This column gives the weights, in grams, of the containers listed in the first column when they are empty of their contents - there are 454 grams in one pound. Note that on a per weight basis, recycling aluminum cans saves the most energy and CO2. A single can of aluminum weighs only 14 grams and recycling it saves nearly 1 kWh of energy and half a pound of CO2. A pound of mixed paper saves 3.4 kWh of energy and 3.9 pounds of CO2, but it weighs 32 times more than the aluminum can.

Sources: Choate et al. (2005) *Waste Management and Energy Savings: Benefits by the Numbers*. Report to the Environmental Protection Agency; EPA (2006) *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks* (3rd edition)*.*

Example 1: Calculating Energy and CO2 Savings from Recycling Aluminum Cans and Cardboard

Let’s say that during the semester you set up a recycling campaign in your apartment house or dormitory, and that you collect 200 aluminum cans and 50 pounds of cardboard and deliver them to the recycling center. Using the above table, you can quantify the energy and CO2 savings as a result of your effort.

Energy savings:

Aluminum cans: 200 x (0.94 kWh) = 188 kWh

Cardboard: 50 x (3.36 kWh) = 168 kWh

Total: = 356 kWh

CO2 savings:

Aluminum cans: 200 x (0.47 pounds CO2) = 94.0 pounds CO2

Cardboard: 50 x (3.43 pounds CO2) = 171.5 pounds CO2

Total: = 265.5 pounds CO2

Example 2: Calculating Multiple Benefits from Walking as an Alternative to Driving Your Car

Let’s say that instead of driving, you walk 30 minutes from home to class and 30 minutes from class to home every day for a month. Since each trip is 2 miles, you walk 4 miles a day. You know the following facts:

* Your car gets 20 miles per gallon of gasoline.
* Burning a gallon of gasoline releases 20 pounds of CO2.
* Burning a gallon of gasoline releases 30,000 kilocalories of energy.
* Walking 2 miles in 30 minutes burns 170 Calories. [See notes (1) and (2) below.]
* Burning off 1 pound of body fat requires you to burn 3,500 Calories (3,500 kilocalories).

From the above information you can do the following calculations:

* Miles walked in 30 days = (4 miles/day) x (30 days) = 120 miles.
* Gallons of gasoline saved = (120 miles)/(20 miles per gallon) = 6 gallons of gasoline.
* Energy saved from avoided gasoline = (6 gallons) x (30,000 kcal/gallon) = 180,000 kcal (equal to 180,000 dietary Calories).
* CO2 saved from avoided gasoline = (6 gallons) x (20 pounds of CO2/gallon) = 120 pounds of CO2.
* Dietary Calories burned in 30 days = (2 x 170 Calories/day) x (30 days) = 10,200 Calories (10,200 kilocalories).
* Pounds of fat you have burned off in 30 days = (10,200 Calories/3,500 Calories/pound) = 2.9 pounds of body fat.
* The energy efficiency of walking compared to driving = (10,200 kcal walking)/(1800,00 kcal driving) = 0.057 = 5.7 % [Walking uses only 5.7% of the energy you expend when driving.]

You could do similar calculations for riding your bike instead of driving. The only difference would be that your Calories burned would be different from what you burned when walking. Go to a bike Calorie calculator on the web, for example at: http://www.healthstatus.com/cgi-bin/calc/calculator.cgi

Notes: (1) A dietary “Calorie” is actually equal to a “kilocalorie” in the metric system. So when burn 170 Calories during your 30-minute walk, you are really burning 170 kilocalories. This number is based on a 150 pound person.

(2) You should do the calculations for your specific action, which will probably differ from the example in terms of minutes walked, miles covered, and body weight. An on-line calorie calculator will do this for you. A good one to use is: http://walking.about.com/library/cal/uccalc1.htm

Example 3: Calculating Multiple Benefits from Reducing Electricity in Your Home

A light fixture [or any other electric appliance] has a certain power rating expressed in “watts”; for example, your reading lamp may have a 60-watt bulb. The watt is a measure of power, not energy - energy equals [power] x [time]. If you read from your lamp for 2 hours, the energy you consume is:

energy = [power] x [time] = [60 watts] x [2 hours] = 120 watt-hours

Your utility company considers “watt-hours” to be too puny of a unit; it measures your energy consumption in kilowatt-hours (kWh). If you look at the electricity bill from your utility, it is always listed in kWh. There are 1,000 watt-hours in one kWh - to convert watt-hours to kWh, you simply divide by 1,000. Thus, for the two hour use of your reading lamp, kWh usage was:

energy = [120 watt-hours]/1,000 = 0.12 kWh

You can assume that you pay your utility about 5 ¢/kWh used. Also note that for every kWh saved, you avoid about 2 pounds of CO2 emissions.

Continuing with the analysis, say you replaced ten 60-watt incandescent bulbs in your apartment with new, super-efficient 13-watt compact fluorescent lights (CFLs). [Yes, a 13-watt CFL puts out the same intensity of light as a 60-watt incandescent bulb.] Assume your ten lights were on for 100 hours each during a month. If you had remained with the 60-watt bulbs, you would have used [10 x 60 watts] x [100 hours] = 60,000 watt-hours = 60 kWh per month. Switching to the 13-watt CFL bulbs would have changed your energy usage to [10 x 13 watts] x [100 hours] = 13,000 watt-hours = 13 kWh per month.

You now have enough information to calculate the benefits per month of your CFL replacement:

|  |  |  |  |
| --- | --- | --- | --- |
| Type of fixture  **Example only** | Energy used  (kWh) | Money spent  (@ 5 ¢/kWh) | CO2 emitted  (2 lbs/kWh) |
| Incandescent | 60 | $3.00 | 120 pounds |
| CFL | 13 | 65 ¢ | 26 pounds |

So from replacing just ten 60 watt incandescent bulbs, you saved $2.35 and 94 pounds of CO2 per month. This translates to about $9.40 and 376 pounds of CO2 per semester, and $28.20 and 1,128 pounds of CO2 per year.