

**Reducing Your Footprint:  
A Handbook for Reducing Household  
Carbon Dioxide Emissions  
(2<sup>nd</sup> Edition)**

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# Reducing Your Footprint: A Handbook for Reducing Household Carbon Dioxide Emissions (2<sup>nd</sup> Edition)<sup>1</sup>

## Introduction

Many citizens feel increasing concern for the impacts humans are having on the natural environment. These people see population growth and economic development as a potential threat to our way of life on earth, at least as we currently enjoy it (Steffen et al., 2011). There is growing certainty among climate scientists that changes humans are making to the chemistry of the atmosphere are leading to global climate change (IPCC, 2013). Scientists agree that we can already see these effects in Maine and the Maine climate is likely to continue to change due to human actions in the future (Fernandez, et al., 2015).

To date, much of the debate around climate change focused on government actions, such as the U.S. decision not to ratify the Kyoto protocol on climate change or state and local government adoption of voluntary greenhouse gas emission reductions (Bogdonoff and Rubin, 2006). Increasingly, people realize the power of changes in individual behaviors to reduce greenhouse gas emissions and improve environmental quality. “Foot printing” exercises now help individuals estimate their personal impact on the environment. One of the first versions of this approach was the “ecological footprint,” a device that has been applied to both individuals and to nations. (See: [www.footprintnetwork.org/index.php](http://www.footprintnetwork.org/index.php)) In addition to these excellent generalized exercises, there are a number of specific “carbon footprint” calculators for individuals. (See: [www.carbonfootprint.com/](http://www.carbonfootprint.com/))

These are excellent tools for raising awareness and for making general estimates of individual or household impacts. They are, at best, rough estimates of your carbon emissions or other environmental impacts; but they are not refined enough to provide you with specific information you can use to reduce your emissions. While awareness is good, the next step is action. This handbook is designed for individuals and

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families who want to reduce their environmental impacts in a systematic way. It is designed to allow citizens to make specific calculations of their carbon dioxide emissions and then to reduce these emissions over time. The framework for accomplishing this is the environmental management system (EMS), a process used by corporations, governments, and other large organizations around the world. This handbook will provide you with a step by step approach to developing your own personal EMS and give you a systematic approach to first measure and then reduce your impacts.

## Environmental Management System Approach

Environmental Management Systems are an application of modern quality management tools designed to improve environmental performance of organizations. The most widely used systems meet the ISO 14001 Standard (Block, 2007). The ISO 14001 Standard was adopted by the International Organization for Standardization in 1996 and revised in 2004. It is a model that is applicable to households as well as large organizations.

The standard is based on the management model developed by W. Edwards Deming, sometimes also known as the Shewhart cycle -- **plan, do, check, act**. (Figure 1.)

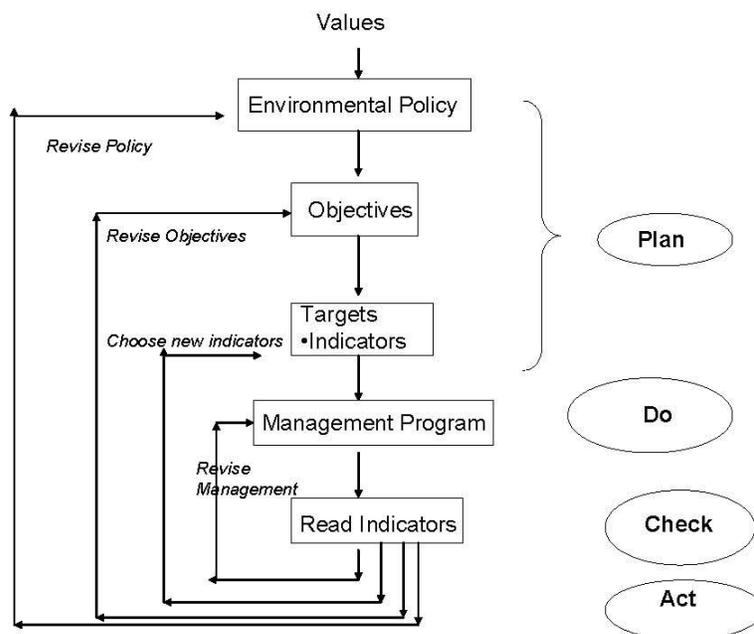


Figure 1. Plan -- Do -- Check -- Act Cycle Applied to Environmental Management

This same basic approach can be applied to the individual or household wishing to reduce its environmental impact. The beginning of the process is to think about what is important to you in terms of the environment -- your environmental **values** (see Anderson and Teisl, 2012). Do you think humans have a moral or ethical obligation to limit their impact on the environment or on other species? Are you concerned that humans are living in such numbers or in a manner that threatens the ability of the Earth to continue supporting our species? Are you concerned that the present generation of humans may be making the planet a more challenging place for future generations? Whatever your motivation, if you feel you should have less impact on the environment then you have what we might call your personal **environmental policy**. A personal environmental policy is the start of a commitment to improving the environment.

The next step in the process is to think about the **objectives** you want to set for yourself in light of your personal environmental policy. How much do you want to reduce your impact on the environment? In what areas do you want to focus your efforts?

To set your objectives, begin by making an inventory of the effects you have on the environment. These effects are called environmental **aspects** in environmental management. For purposes of this handbook we are using carbon dioxide emissions as the basic measurement of environmental impact. Most of your household impact on the environment comes from energy use, and carbon dioxide emissions are a good way to measure that impact.

By keeping track of your monthly energy purchases you can begin to build a picture of your household's emissions in the aggregate and by source. You are then identifying the aspects of your life that have significant impacts on the environment, the aspects that create the biggest carbon emissions.

It can be difficult to identify exactly when you use energy and thus the carbon emissions they create. So rather than worrying about when you actually use the energy, simplify the process by keeping track of your aspects by when you pay for the energy. If your bill for electricity used in December comes in January, just enter the amount of energy you paid for in January, the month you paid for it. Energy purchases are often "lumpy" in that you may buy fuel in a certain month and then burn it over the next several months. The goal here is not to make month to month energy consumption comparisons. Rather, the idea is to look at the longer term, perhaps comparing energy consumption from year to year. This first step in the process is just

to begin tracking your energy consumption. This handbook and the Excel spreadsheet that goes with it will help you convert energy use data into carbon emissions.

Once you have begun to identify the environmental aspects of your household, you can begin to think about your objectives (see Figure 1. again). Your objectives might be an overall goal, for example, reduce emissions by 10%. Objectives might be expressed in terms of a long term trend, reduce emissions by a certain percentage each year for the next decade. Or they might be specific to one of your aspects, reduce emissions from electricity use or from gasoline consumption, while making sure that all other emissions do not increase. One of the values of identifying environmental aspects and beginning to keep track of emissions from each aspect is that it allows you to see where your greatest impact currently is. Perhaps then that area is where you could make the greatest reductions in your footprint.

A different approach to objectives is to think about your relative contribution to larger environmental concerns. For example, what emissions levels for our household would contribute to climate stabilization? Chakravarty et al. (2009) argue that annual per person CO<sub>2</sub> emissions should be capped at about 10 metric tons in order to achieve climate stabilization in a fair manner. Where would your household stand if this were the cap on per person emissions? The spreadsheet that goes with this handbook can help you answer that question.

You have now identified the means you are going to measure your progress with, your **environmental indicators**. This handbook is designed to use carbon dioxide emissions as the indicator of environmental impact. You can measure progress toward the goals and objectives by continuing to measure energy purchases which the spreadsheet will convert into carbon dioxide emissions for you. The next step in the process is to figure how you are going meet your objectives, your **program**.

## **Devising Your Program**

Everyone's program will be different, depending on personal circumstances. Below are some ideas for emissions reductions that you can tailor to your own specific needs. By thinking about some of these ideas you may come up with programs of more relevance to you. There is no one way to develop programs and everyone's program will be different.

Electricity Usage. A lot of electricity in the U.S. is generated by burning coal, natural gas, or oil to boil water and make steam to turn a turbine. So even though electricity itself is clean, it may generate greenhouse gases to make it. Here are some ideas for reducing power consumption in your home:

- Be sure that any new appliance you purchase is EnergyStar rated -- see: [www.energystar.gov/](http://www.energystar.gov/)
- Unplug appliances and consumer electronics when not in use. By some estimates, “standby power” accounts for as much as 10% of the electricity consumption in the U.S (Pulling the Plug on Standby Power, 2006). Instant-on features in appliances and electronic equipment add a few seconds of convenience to your life at the cost of a lot of electricity.
- Replace incandescent light bulbs and compact fluorescent light bulbs or LED units, and turn off the lights when you leave a room.
- If you heat water with electricity, install low-flow shower heads or consider an “on-demand” water heater, perhaps powered by propane or natural gas.
- Make sure you do not have an old refrigerator in the basement with little or nothing in it. Dispose of this carefully in case it is old enough that it contains chlorofluorocarbons as a refrigerant.
- When you use your stove or oven, use only as much power as you really need. For example, if you are making a cup of tea, measure just a tea cup full of water into your pot. Your water will boil more quickly and you will only use the energy you need to fill one cup. Heat your water with a microwave oven.
- Consider alternative sources for your power purchase.

Gasoline Consumption. For many Americans, burning gasoline in cars is the single largest source of carbon emissions, so this is an area where you may be able to make the largest reductions. Emissions are a function of two factors -- the fuel efficiency of the vehicle and the number of miles driven. Finding the will to change driving habits is the challenge, because the car is an incredibly convenient and comfortable device for most of us. Here are some ideas:

- Buy a car that gets higher fuel economy.
- Keep your car well maintained -- tune ups and tire pressure maintenance both help.
- Accelerate more gradually and drive more slowly. For many vehicles, driving around 55 miles per hour does give better fuel economy.
- Drive fewer miles:
  - Use a bicycle or walk (and you could also improve your health

in the process)

- Consolidate trips
- Avoid “unnecessary” trips
- Take public transportation
- Car pool

• Beyond making changes in your car habits, make your lawn smaller so that you do not run lawn and garden equipment as much. If you are able to, use manual alternatives to gasoline-powered lawn mowers or snow blowers.

- Reduce or eliminate the use of other devices that burn gasoline.
- If you are relocating, consider how pedestrian-friendly or bike-friendly locale is as part of your housing purchase decision.

Home Heating Fuels. Americans heat their homes and their domestic hot water with a diversity of fuel types -- #2 oil, propane, natural gas, wood, and kerosene are among the most common. The combustion of all of these produces carbon dioxide, although some are much cleaner than others, both in terms of the efficiency of converting the fuel into heat and in terms of the carbon content of the fuel. Whatever fuel type you are using there are similar strategies to use less.

• Weatherize your home -- new windows, weather stripping, storm doors, etc. Many resources are available to help in this endeavor.

[www.energystar.gov/index.cfm?c=home\\_improvement.hm\\_improvement\\_index](http://www.energystar.gov/index.cfm?c=home_improvement.hm_improvement_index)

- Consider upgrading your furnace or other heating unit to a newer, more efficient model.
- Turn the thermostat down a degree or two or leave some rooms of the home unheated when they are not being used.
- Turn the thermostat down at night and throw on another blanket.
- If you are building a new home, think about making it smaller. Less space to heat means less fuel burned.

Municipal Solid Waste. A lot of wastes generated at home end up being burned to produce electricity. Otherwise the wastes are placed in a landfill. Municipal solid wastes generate greenhouse gases, about 60 pounds per typical 33 pound bag of waste. So, waste reduction reduces carbon dioxide emissions.

- Recycle all the plastic, glass, metal, and paper that you can in your community.
- Urge your local government to contract for single-stream recycling.
- Take your name off catalog mailing lists. Mail order catalogs consume large amounts of paper each year and generate unnecessary solid waste. Shopping on line

may not be quite as convenient for you, but it will generate a big reduction in impacts.

- Compost food waste and other organic products; better yet, reduce the amount of food you let go to waste. Buy only what you need and eat all that you buy.

- Buy products with less packaging; better yet, buy less so that you have less to throw away. Take a look at your waste some day and see if there are things in there that you could have done without and still have been happy.

Airline Miles. Airline travel is expensive, particularly in terms of energy used per mile traveled. An average figure is that you generate about 0.9 pounds of carbon dioxide for every air mile traveled. (The issue of air travel impacts is complex, so this is just a simplified assumption. See Kollmuss and Bowell, 2006.) The message here is not that you should avoid all airline travel, just as you should not avoid driving a car altogether. Rather, it is that flying a little less can have a big impact on reducing your carbon dioxide emissions. To find out what the specific emissions are for your air travel, the International Civil Aviation Organization provides an excellent on-line tool: <http://www.icao.int/environmental-protection/CarbonOffset/Pages/default.aspx>

These are just some of the programs you might adopt to reduce your carbon emissions and many of these can have a noticeable effect on the per person carbon dioxide emissions in your household. You can probably think of many more. There are other ways of approaching your impact that are not quite as easily measurable as these, but you may want to think about them as well. There are many other web-based resources to help you in this process. A particularly good one is:

[http://www.davidsuzuki.org/Climate\\_Change/What\\_You\\_Can\\_Do/at\\_home.asp](http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/at_home.asp)

### Food and Beverage

There is not a part of the process here for estimating the specific emissions attributable to food and beverage consumption. There is no easy way to calculate this directly as you can in the other areas of your environmental impact. There are a number of estimates of carbon emissions from the food system in the aggregate. For example Bin and Dowlatabadi (2005) suggested that 1997 food and beverage consumption in the U.S. created emissions of 426 Mt of CO<sub>2</sub> in 1997. This would translate into about 1.5 tons of emissions per person. Once you have calculated your emissions from other sources using the spreadsheet, you should add at least 1.5 tons of emissions to your total to account for food and beverage consumption. Eating more of a vegetarian diet will directly reduce your greenhouse gas emissions (Stehfest et al., (2009).

## **Other Programs and Metrics**

One of the best measures of overall impact is your consumption of goods and services. Whatever we buy -- food, clothing, trips, electronic devices -- requires matter and energy for production, marketing, and distribution. So one simple way of measuring your impact on the environment is how much you spend in total each year. As a general rule, the more you spend, the greater your impact, the less you spend, the less your impact. Of course, this is an imperfect indicator since not all expenditures have the same environmental impact. If you are someone who equates your wellbeing with consumption of stuff, it is going to be hard to reduce your environmental impact (Leonard, 2010). But if happiness for you comes from intangibles, it might be easier. (See Layard, 2006.)

Another proxy for environmental impact that is easy for many people to measure is water use. If you are on a municipal water supply and have a water meter on your supply line, keep track of water use. For many people, less water use may be a sign of overall lower energy consumption.

Another indirect but potentially effective strategy for reducing environmental impact has to do with gift giving. Consider replacing gifts that you might give for holidays, birthdays, and other special events with gifts to charity instead. Some research suggests that as many as half the gifts given in America are exchanged for something else. Gifts to charities can be more meaningful and reduce the consumption of goods and services that leads to environmental impact. Consider also giving people the gift of absolving them from the obligation of giving you a gift. Or give people a gift of your time. The New American Dream web site can help you think about this issue ([www.newdream.org/](http://www.newdream.org/)).

## **Conclusions**

Changing how we live is not easy and the goal here is not to be everyone into hermits. Rather, as citizens of our communities, the idea is to figure how to live well, to enjoy fulfilling lives, and to leave our natural environment so that others may do the same for years to come.

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## Appendix: Notes on Personal Carbon Emissions Worksheet

The personal carbon emissions worksheet is a simple Excel spreadsheet that uses standard carbon dioxide emission factors for various activities and fuel types:

<http://umaine.edu/soe/files/2009/06/Reducing-Your-Footprint-2nd-ed.-carbon-calculator-spreadsheet.xls>

Simply follow these steps and fill in the data for each month of the year. As noted above, to simplify the process, record data (gallons of gasoline, kWh of electricity, etc.) for energy purchases when you buy the energy rather than trying to estimate when you use energy directly. It will make the process easier. The goal is not to try to reduce your impacts from month to month, because energy use and purchase is clearly “lumpy” over time. Rather, the goal is to reduce your consumption on a longer time scale, say on an annual basis.

1) The first step in your worksheet is Section 1. Fill in the number of people in your household. Using total household energy use values you put into Section 4 of the spreadsheet each month, it will then calculate both total and per person carbon dioxide emissions estimates in Section 3.

2) Section 2 includes CO<sub>2</sub> conversion factors derived from public sources. You may wish to change some of these to match your personal situation. All of these conversion factors except for air travel are based on data from U.S. Department of Energy (2007). Carbon emissions from electricity generation will differ depending upon the fuel used for generation. Some states, like Maine, now require electric utilities to provide customers with specific emission data for their power source. If you have such information then replace the 0.53 (0.53 represents the kilograms of CO<sub>2</sub> emission for each Kwh of electricity used) value in the spreadsheet with a value specific to your electricity supply.

Emissions for burning wood are on a per cord basis since that is how most people purchase wood supplies. U.S. Department of Energy estimates that burning a short ton of wood or wood waste generates 1864 kg of carbon dioxide. The weight of wood varies by species and the extent to which it is dried. For purposes of this calculator we used the value of red oak, air dried of approximately 1716 kg (Utah State University, 2007). So a cord of wood would be 1.71 tons and thus would generate 3183 kg of carbon dioxide per cord.

The Department of Energy (2007) says about wood burning, “These biofuels contain ‘biogenic’ carbon. Under international greenhouse gas accounting methods developed by the IPCC, biogenic carbon is part of the natural carbon balance and it will not add to atmospheric concentrations of carbon dioxide.” That said, you should still count these carbon emissions if you want to be honest with yourself about your impact on the environment. By logic employed by the Department of Energy here, you could consider fossil fuels to be “biogenic” and part of the natural carbon cycle, you just need to assume a much longer time scale for what you call “natural.” The simple fact is that once carbon dioxide goes into the atmosphere, its effects on climate systems are the same wherever it comes from, fossil fuels or biomass. The real question is not where your carbon emissions come from in terms of fuel, rather it is one of how large your emissions footprint is from all sources. What does this all mean: count your emissions from burning wood.

Air travel is particularly difficult because of the high degree of variability of effects on climate due to both the length and altitude of flights. Short haul flights generate more carbon emissions per mile, since takeoff and landing consume a disproportionate share of the fuel used in air travel compared to cruising. On the other hand, long haul flights typically fly at higher altitudes where emissions have a greater radiative forcing effect (Kolmuss and Bowell, 2006). The original carbon calculator for this publication used .9 pounds of carbon dioxide per air mile flown as a conservative average emission value. For the revised calculator use the ICAO (2012) on-line emissions tool in order to get a more accurate value based on specific flight legs:

<http://www.icao.int/environmental-protection/CarbonOffset/Pages/default.aspx>

After you have traveled by air you need only have the airport designators for each leg of the trip to use the ICAO calculator (for example BGR to LGA for Bangor, Maine to LaGuardia in New York.) This is the one manual part of the spreadsheet process; you will need to input each month the carbon dioxide pounds for each trip air taken that month.

3) Once you have kept track of these data for a year, you are ready to implement your **programs**. Look at those areas where you generate the most emissions. Can you find ways to reduce energy use in these areas? What are the easiest changes you could make? Can you reduce your carbon emissions next year? Why not set a goal for yourself? Now you are on your way to truly reducing your impact on the environment -- you are reducing your footprint.

Do you have questions or need help with your calculator?  
Contact the author: [marka@maine.edu](mailto:marka@maine.edu) .

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