

PLEDGES

1. Replace Incandescent Bulbs with CFLs.
2. Use a Power Strip for Electronics and Turn it Off When Not in Use.
3. Shorten Showers.
4. Warm Up Smart and Cool Down Smart.
5. Go Meatless X2
6. Maintain Your Home Turf Efficiently.
7. Plant a Tree.
8. Wash Your Clothes on Cold.
9. Recycle Bottles, Cans and Paper.
10. Ride a Bike Instead of Driving.

1. Replace Incandescent Bulbs with CFLs or LEDs. Replace at least 5 incandescent bulbs with CFLs (compact fluorescent light bulbs) or LEDs.

REDUCTION: 393 lbs of CO₂/year

DOLLAR SAVINGS: Around \$5 in year 1 and \$35/year for the next 6 years: \$30.71/year over 7 years

Compact fluorescent lamps (CFLs) and LEDs consume far less electricity than conventional incandescent light bulbs. This pledge item is based on the following assumptions:

- 5 conventional light bulbs are replaced
- The replaced bulbs are 75 watts each, and were replaced with equivalent CFLs or LEDs
- The CFLs consume 27 percent of the electricity of the conventional bulbs; as of 2012, LEDs consume a similar amount
- Each light is turned on 3 hours per day

Multiplying the number of bulbs by their wattage and hours on per day gives the daily watt-hours consumed by the conventional bulbs. Multiplying the resulting figure by 73 percent (savings) and 365 days per year, and dividing by 1000 yields an energy savings of 301 kilowatt-hours. Multiplying the energy savings by the 2009 national average electricity emission of 1.22 lbs CO₂/kilowatt-hours¹ and the national average electricity line losses of 7 percent² results in a GHG emissions savings of 393 pounds of CO₂ per year.

- Cost of five 75 watt equivalent CFLs at store is 5 x GE bulbs are around \$6.50 each (7 year life) and generic brand are around \$2.20 - \$2.50 each (life span not specified) Some controversy over how long the generic version of the bulbs last; some reviews say only a few months.

¹ See: <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html>

² See: <http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3>

Energy savings calculation:

Conventional bulb consumes:

$$5 * 75 \text{ Watt bulb} * 3 \text{ hours/day} * 365 \text{ day/year} * 1\text{kW}/1000 \text{ Watt} = 410.625 \text{ kWh/year}$$

CFL bulb consumes:

$$5 * 20 \text{ Watt bulb} * 3 \text{ hours/day} * 365 \text{ day/year} * 1\text{kW}/1000 \text{ Watt} = 109.5\text{kWh/year}$$

Energy Savings: $410.625\text{kWh/year} - 109.5\text{kWh} = 301.125 \text{ kWh/year}$

CO₂ calculation:

$$301.125 \text{ kWh/year} * 1.22 \text{ lbs CO}_2 / \text{kWh} = 367 \text{ lbs CO}_2 /\text{year} * 1.07 = 393 \text{ lbs CO}_2 /\text{year}$$

Note that 75 watt-equivalent CFL bulbs consume 19 or 20 watts depending on the brand.

The national average retail price of electricity for the residential sector (December 2012) is 11.62 cents per kilowatt-hour.³ Therefore, a savings of $301.125 \text{ kWh/year} * 11.62 \text{ cents/kWh} * \$1/100 \text{ cents} = \$34.99$. However, 5 CFL bulbs cost around \$30, so savings in the first year are around \$5 and then \$35 per year for the next 6 years. Because CFL bulbs last an average of 7 years, over a seven-year period the switch will save an average of \$30.71 each year.

2. Use a Power Strip for Electronics and Turn it Off When Not in Use.

Flipping the switch on power strips helps reduce unused electricity from being pulled from the outlet when you aren't using your electronics.

REDUCTION: 470 lbs CO₂/year

DOLLAR SAVINGS: \$42/year

Use a power strip to save electricity by turning off devices when not in use. The strip may have a timer for the devices or be a “smart” power strip, which means that when the device plugged into one master outlet is turned off, the other outlets are turned off automatically.

The amount of electricity savings depends on the magnitude of what is known as “phantom power,” that is the electricity consumed when a device is not in use and amount of time that the device is consuming phantom power.

The savings in this pledge is based on the experience of one individual who used a combination of smart strip (for such devices as wireless internet and computer speakers) and timed power strip (for a cable box and game console) to reduced phantom power consumption⁴. He was able to reduce his electricity consumption by an estimated 35 kilowatt-hours per month or 420 kilowatt hours per year. This pledge item is based on the consumption that someone could reduce consumption by slightly less—30 kilowatt hours per month or 360 kilowatt hours per year. This is equivalent to eliminating a total phantom load of 45 watts for 8000 hours per year (45 watts multiplied by 8000 hours per year and divided by 1000 equals 360 kilowatt-hours). Multiplying 360 kilowatt-hours by the same electricity emission factor and line loss factor as above results in a GHG emission reduction of 470 pounds of CO₂ per year.

The cost savings is equal to 360 kilowatt-hours multiplied by the national average retail price of electricity for the residential sector (December 2012) of 11.62 cents per kilowatt-hour or \$41.83 per year.

³ See: http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_a

⁴ See: <http://www.bravenewleaf.com/environment/2008/01/energy-project.html>

3. Shorten Showers. Shorten your daily showers by 3 minutes to lower water consumption and the energy used to heat water.

REDUCTION: 338 lbs CO₂/year

DOLLAR SAVINGS: \$30/year

Reducing time in the shower saves energy and reduces GHG emissions as a result of not having to heat as much hot water.

The savings for this pledge item are based on the following assumptions:

- The person making the pledge showers once per day
- The time for each shower is reduced by 3 minutes
- 2 gallons of hot water per minute are saved
- 60 degrees F is the temperature rise of the water
- A natural gas hot water heater with an energy factor (efficiency) of 0.6 or an electric hot water heater with an energy factor of 0.9 is used to heat the water

Since water weighs 8.3 pounds per gallon, we can calculate the natural gas saved as 4980 Btu per day (2 gallons per minute x 3 minutes per day x 60 degrees F x 8.3 lb/gallon x 1 (Btu/lb-degree F)/0.6 energy factor) or 1.82 million Btu per year if a gas water heater is used. Based on CO₂ emission of 117.3 pound per million Btu of natural gas combusted, this translates into a CO₂ savings of 213 pounds per year for a gas water heater.

Using the assumptions listed above for an electric water heater results in an annual savings of 355.1 kilowatt-hours (2 gallons per minute x 3 minutes per day x 60 degrees F x 8.3 lb/gallon x 1 (Btu/lb-degree F) x 365 days per year x 0.00029307 kilowatt-hour per Btu/0.9 energy factor). Multiplying this savings by the same electricity emission factor as above (1.22 lbs CO₂/kilowatt-hour) and the line loss factor results in an emission reduction of 463 pounds per year.

According to the American Council for an Energy-Efficient Economy (ACEEE), natural gas is the most common fuel used in U.S. households for heating water, and 40 percent of households heat hot water with electricity⁵. Therefore, the savings for this pledge item is taken as the average savings for a gas and an electric hot water heater: 338 lbs CO₂/year.

The cost savings for a natural gas hot water heater based on an energy savings of 1.82 million Btu per year and a 2012 residential annual average price of \$10.44 per million Btu⁶ is \$19.

The cost savings for an electric water heater based on an energy savings of 355.1 kilowatt-hours and electricity price of 11.62 cents per kilowatt-hour is \$41.26

The cost savings for this pledge item is taken as the average dollar value savings for a gas and electric hot water heater: \$30 per year.

⁵ See: <http://aceee.org/node/3068>

⁶ See: http://www.eia.gov/naturalgas/monthly/pdf/table_03.pdf, and note the conversion factor for thousand cubic feet (Mcf) to MMBtu – divide Mcf by 1.023.

4. Warm Up and Cool Down Smart. When cooling your home, raise the thermostat at night and when you are out. When heating your home be sure to lower the thermostat during these times.

REDUCTION: 1,863 lbs CO₂/year

DOLLAR SAVINGS: \$166/year

Lowering the thermostat during the heating season and raising it during the cooling season when no one is home or when people are sleeping can reduce electricity consumption and fuel costs such as for natural gas. This pledge item is based on the savings in a city chosen to represent the national average—Saint Louis—where air conditioning is commonly used. The energy savings are based on the results of the U.S. EPA calculator for programmable thermostats⁷. The calculator was used with the following assumptions:

- Heating season temperature when not set back: 70 degrees F
- Heating season temperature when set back: 62 degrees F (day or night)
- Cooling season temperature when not set up: 78 degrees F
- Nighttime cooling temperature when set up: 82 degrees F
- Daytime cooling temperature when set up: 85 degrees F
- 8 hours per day temperature not set back or set up
- 8 hours of nighttime set-back or set-up
- 8 hours of daytime set-back or set-up
- Gas furnace heating
- Central air conditioning

The annual energy savings calculated using these assumptions are 529 kilowatt-hours of electricity and 10.0 million Btus of natural gas. Based on 1.22 lb CO₂ per kilowatt-hour of electricity consumed as well as 7 percent average line losses and 117.3 pound of CO₂ per million Btu of natural gas consumed, the energy savings translate into a GHG emission reduction of 1823 lbs of CO₂ per year.

The dollar value savings for these thermostat adjustments based on an energy savings of 529 kilowatt-hours at 11.62 cents per kilowatt-hour and 10 million Btus at \$10.44 per million Btu is \$166 per year.

5. Go Meatless X2. This year, cut out meat from your meals two days a week.

REDUCTION: 342 lbs CO₂/year

A meat based diet requires a carbon-intensive agriculture system. This pledge assumes the average American consumes more than 100g meat per day on a 2000 calorie diet, which leads to 7.19 kg CO_{2e} emissions per day. By choosing a meat-free diet (but allowing for fish consumption) the average American would reduce

⁷See: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TH

his/her daily food-related emissions down to 3.91 kg CO₂e. Doing so twice a week for a full year would lead to 342 lbs of avoided carbon emissions.

6. Maintain Your Home Turf Efficiently. This year, eliminate the use of lawn fertilizer, reduce watering and the number of times you mow the lawn.

REDUCTION: 435 lbs CO₂/year

DOLLAR SAVINGS: \$373/year

Lawn maintenance results in the emissions of GHGs in several different ways. Watering lawns requires energy to treat and transport the water, which results in emissions from energy consumption. Mowing lawns results in emissions from the lawn mower. Fertilizer application is a major source of emissions, not only due to the energy and emissions associated with the fertilizer manufacture, but also as a result of nitrogen in the fertilizer being converted to nitrous oxide, a potent greenhouse gas, an subsequently being emitted to the atmosphere.

Emissions reductions from less intensive lawn maintenance are based on the paper of Jones⁸, which evaluated the emissions per 1000 square feet of lawn for various maintenance practices. The emission reductions calculated for this pledge item are based on the assumption that a lot one-quarter acre in size (10,890 square feet) is being maintained. The following assumptions are made about the change in management practices for this lot:

- Watering is reduced by 10 inches per year
- Fertilizer use is eliminated (reduction of 3.33 lbs of Nitrogen per 1000 square feet)
- 5 lawn mows are eliminated each year

Based on Jones's CO₂ emission reductions per 1000 square feet of 34 pounds by eliminating watering (38.7 inches), 29 pounds of CO₂ by eliminating fertilizer, and 15 pounds of CO₂ by eliminating 35 mows, a total reduction of 435 lbs of CO₂ would result for a quarter acre lot under the assumptions listed above.

Cost savings would come primarily from the reduction of water use. Eliminating 10 inches of watering over one quarter acre amounts to 67,886 gallons of water. Using the national average marginal costs for water and sewer charges of \$5.49 per 1000 gallons⁹, results in an annual savings of \$373.

7. Plant a Tree. Plant to the South or West side of your home to save on air conditioning.

REDUCTION: 446 lbs CO₂/year

DOLLAR SAVINGS: \$21.50/year

⁸ Pierce Jones, Land Development, Landscaping and Greenhouse Gas Emissions (undated) Program for Resource Efficient Communities, University of Florida.

⁹ 2012 U.S. average water and sewer rates (first block) from American Water Intelligence:
<http://www.americanwaterintel.com/archive/3/9/analysis/utilities-gun-shy-water-and-sewer-rate-hikes-2012.html>

Energy savings associated shade trees was taken directly from a paper on the subject by Donovan and Butry¹⁰. This paper estimated the summertime electricity savings of shade trees to be 185 kilowatt-hours. Using the same emission factor as above, this translates into 226 lbs of CO₂ emission reductions. An additional 220 lbs of emission reductions occur annually as a result of sequestration by the planted trees. This additional reduction is based on the average annual CO₂ sequestration by London plane trees during their first 70 years. Cost savings from using 185 kilowatt-hours fewer of electricity at the national average of 11.62 cents per kilowatt-hour are \$21.50 per year.

8. Wash Your Clothes on Cold. Washing your clothes with cold water instead of hot can save 85% of the energy used when doing laundry.

REDUCTION: 247 lbs CO₂/year

DOLLAR SAVINGS: \$22/year

Energy and GHG emissions result from using less hot water, such as by washing clothes in cold water instead of hot or warm water. The savings for this pledge item are based on data in the Make an Impact Calculator for conventional residential washing machines. These data include the total electricity and natural gas used per year for typical machines. The data were updated in June of 2012 to be consistent with the most recent EPA washing machine data.

The CO₂ emission reductions for this pledge item are based on the average of the savings achieved by a conventional washing machine served by a gas hot water heater and one served by an electric water heater. The calculations are based on the following assumptions:

- A conventional washing machine and electric water heater consume 252.3 kilowatt hours per year for water heating
- A conventional washing machine and gas water heater consume 1.41 million Btus per year for water heating
- Washing clothes in cold water eliminates the use of the water heater for clothes washing

At 1.22 lbs CO₂/kilowatt-hour and 7 percent line losses, 329 lbs of CO₂ per year would be reduced by washing all clothes in cold water based on use of an electric water heater. At 117.3 lbs per million Btu of gas, 165.4 lbs of CO₂ per year would be reduced by washing all clothes in cold water based on use of a gas water heater. The average of these reductions is 247 lbs CO₂/year.

The cost savings for the elimination of electric water heating equal to 252.3 kilowatt-hours and electricity price of 11.62 cents per kilowatt-hour is \$29.32.

The cost savings for eliminating natural gas hot water heating of 1.41 million Btu per year and a natural gas price of \$10.44 per million Btu is \$14.72.

The dollar value savings for this pledge item is taken as the average dollar value savings for eliminating gas and electric hot water heating: \$22 per year.

¹⁰ The value of shade: Estimating the effect of urban trees on summertime electricity use. Geoffrey H. Donovan and David T. Butry, Energy and Buildings, 41, June 2009.

9. Recycle Bottles, Cans and Paper. Recycle 5 plastic bottles, 5 aluminum cans and all paper products each week.

REDUCTION: 249 lbs CO₂/year

Energy and GHG emissions result from recycling because it generally takes less energy to make products from recycled materials than from virgin materials. Energy savings from recycling the various materials comes from a U.S. EPA report on the life-cycle emissions from various solid waste management options¹¹. GHG emission reductions come from the EPA's Waste Reduction Model WARM¹², and represent the difference between emissions under the baseline disposal scenario and recycling.

The calculations are made using the following assumptions and data:

- 5 plastic bottles, 5 aluminum cans and 1/2 pound of paper are recycled each week
- 34 aluminum cans weigh one pound
- 18 plastic bottles weigh one pound

Thus 14.4 pounds of plastic, 7.6 pounds of aluminum, and 26 pounds of paper are assumed to be recycled per year.

The EPA reports energy savings of 26,700, 103,450, and 5100 Btu per pound for recycling plastic (PET), aluminum, and office paper, respectively. Applying these figures to the weight of each assumed to be recycled by this pledge item results in energy savings of 1.03 million Btu per year.

The EPA's WARM model predicts that the savings associated with recycling plastic, aluminum, and paper amount to 1.58, 13.7, and 4.69 pounds of CO₂e per pound recycled. Based on the annual quantities of materials recycled as listed above, GHG emission reductions of 249 pounds per year result.

10. Ride a Bike Instead of Driving. Replace 10 miles of driving with walking or riding a bike.

REDUCTION: 481 lbs CO₂/year

DOLLAR SAVINGS: \$88/year

- Driving is reduced by 10 miles per week or 520 miles per year
- The fuel efficiency of the car is 21 miles per gallon

These assumptions result in a savings of 24.8 gallons of gasoline, which is equivalent to 3.08 million Btu (at 124,200 Btu/gallon). Using an emission factor of 150.5 lbs of CO₂ per million Btu of gasoline results in a GHG savings of 481 pounds of CO₂. The energy content and the emission factor used here come from the Make an Impact calculator.

- Assuming an average price for regular gasoline of \$3.55 per gallon (Energy Information Administration forecast for 2012 – 2014), Using 24.8 fewer gallons per year results in a savings of (\$3.55 x 24.8 = \$88.04 per year).

¹¹Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 3rd edition, September 2006. EPA530-R-06-004.

¹² See: http://www.epa.gov/climatechange/wycc/waste/calculators/Warm_home.html