

Your Local Weatherization Program's Greenhouse Gas Reductions in Layperson's Terms: *A How-To Guide*

Step 1: Calculate your program's CO2 emissions reductions.

The calculation used by DOE and for the national paper is based on the average natural gas weatherized home. It burns 32% less natural gas and therefore emits 1.62 fewer metric tons of CO2 yearly.

Why use this natural gas figure? If most of your weatherized units burn fuel oil or propane for heat AND you are confident of your savings/usage reduction, you could use higher figures.¹ Otherwise, this national average conveniently covers a mix of heating fuels and results. The usage reductions are backed up by the most recent ORNL Weatherization Meta-evaluation. It will understate carbon reduction in homes that use more than the average fossil-fuel-based energy. However, to avoid doing the math for each home's before-and-after fossil-fuel-based usage, the national average is a well-researched figure and simple to use.

Multiply the number of houses that you weatherize annually by 1.62 (that's **metric tons**) to find the emissions reduced over one year. Multiply that number by 20 to find the reductions over 20 years (20 years is the assumed life of all the measures).

Example: Your program weatherizes 500 homes annually. The CO2 emissions reductions over 20 years are 16,200 metric tons (1.62 metric tons CO2 x 500 homes x 20 years = **16,200** metric tons CO2 saved over 20 years). We will use 16,200 as the example in the following steps.

Step 2: Find visual images that convey what 16,200 metric tons less CO2 means.

Step 2a: Enter your program's CO2 reductions into the EPA's Greenhouse Gas Equivalencies Calculator <http://www.epa.gov/solar/energy-resources/calculator.html>

On this site, scroll down the page to **Option 2**. On the *Carbon Dioxide* line, input your program's total CO2 reductions (16,200) into the **Amount** box and select *metric tons* from the **Units** drop-down list.

Step 2b: Click on the Calculate Equivalencies button, then scroll down to **Equivalency Results** and you will see the equivalent of avoiding 16,200 metric tons of CO2 expressed in 13 different ways.

http://www.epa.gov/solar/energy-resources/calculator.html

This calculation should not be used for emission inventory or carbon trading exercises.

- To estimate indirect greenhouse gas emissions from electricity use, please use [Power Profiler](#) or use eGRID subregion annual output emission rates as a default emission factor (see [eGRID2007 Version 1.1 Year 2005 GHG Annual Output Emission Rates \(PDF\)](#) (1 p, 200K, [About PDF](#))).

Option 2:

If you have already estimated the quantity of avoided emissions (e.g., metric tons of carbon dioxide equivalent), you can input the amount of avoided emissions and select the appropriate units for the corresponding greenhouse gas type.

| Amount | Unit | Gas |
|----------------------|------|---------------------------------------------------------|
| <input type="text"/> | Tons | CO ₂ - Carbon Dioxide |
| <input type="text"/> | Tons | CH ₄ - Methane |
| <input type="text"/> | Tons | N ₂ O - Nitrous Oxide |
| <input type="text"/> | Tons | HFC-23 - Hydrofluorocarbon gases |
| <input type="text"/> | Tons | CF ₄ - Perfluorocarbon gases |
| <input type="text"/> | Tons | SF ₆ - Sulfur Hexafluoride |
| <input type="text"/> | Tons | Carbon Equivalent |

*If your estimated emissions of methane, nitrous oxide, or other non-CO₂ gases are already expressed in [CO₂ or carbon equivalents](#), please enter your figures in the row for CO₂ or carbon equivalent.

The sum of the greenhouse gas emissions you entered above is Metric Tons of Carbon Dioxide Equivalent.

This is equivalent to one of the following:

Equivalency Results

Click on the question mark ? link to read the explanation of that particular calculation. [Read about all calculations.](#)

The information you entered above is equivalent to one of the following statements:

Annual greenhouse gas emissions from passenger vehicles ? ([click to read more about this calculation](#))

Step 3: Use the EPA's equivalencies as a base for making local visual examples.

These are the images used in the EOS national paper:

➤ **" Shutting down a coal-fired power plant for x hours"**

The EOS million-unit example, shut-down coal plants *per year*, is too large-scale. The EPA's calculator tells us that 16,200 metric tons of CO₂ is equivalent to the annual emissions of zero coal-fired power plants.]

You can use the tool to calculate *hourly* emissions, and then figure out how many hours a coal plant would be shut down in order to avoid the CO₂ emissions equivalent to your Weatherization program's results.

On the EPA site, click on the "?" following power plants; it will take you to the page which explains all of the CO₂ Calculator's calculations. It shows that the annual emissions of the average coal-fired power plant are roughly 4,643,734 metric tons CO₂.



Calculate the daily figure. Divide that 4,643,734 by 365; one plant emits 12,722.55 metric tons CO₂ per day. Your program will save 3,477 MT more than that this year, but not an entire day more. You need to be able to say how many hours or fraction of a day more.

Get the hourly figures. Divide 12,722.55 (from above) by 24 and you learn that one average plant emits 530 metric tons CO₂ per hour. Therefore, the 16,200 metric tons of CO₂ "avoided" by your Weatherization program is equivalent to shutting down one coal-fired power plant for over 31 hours.

Closer to home? In order to make this example more relevant to your local audience, find a coal-fired power plant in your area and find out how much CO₂ it emits per year. Sierra Club has a list of coal-fired power plants by state on their website (<http://www.sierraclub.org/environmentallaw/coal/plantlist.asp>). Caution - The Sierra Club annual CO₂ emissions are listed in tons, and will need to be converted to metric tons before you calculating the hourly emissions. 1 ton = 0.907 metric tons; therefore, multiply the emissions on the Sierra Club site by .907.

Calculate the number of hours it would have to be shut down in order to reduce the amount of CO₂ emissions equivalent to the reductions achieved by your program. Of course, smaller plants will be shut down for longer.

➤ **"Keeping xx railcars full of coal idle in their rail yards because they are no longer needed to carry the coal supply to the power plant"**

This example may be more dramatic than the hours a coal plant is shut down, because it is so easy to visualize. (Need a graphic? Contact us to get a copy of our coal train jpg file: info@opportunitystudies.org).

If you use above example of shutting down a power plant for a few hours, this image can accompany it as a way to visualize the amount of coal that will not be carried to the plant and burned.

Railcars of coal burned

Average heat content of coal in 2005 was 22.68 million btu per metric ton (EPA 2007). Average carbon coefficient of coal in 2005 was 25.34 kilograms carbon per million btu (EPA 2007). Fraction oxidized is 100 percent (IPCC 2006).

Carbon dioxide emissions per ton of coal were determined by multiplying heat content times the carbon coefficient times the fraction oxidized times the ratio of the molecular weight of carbon dioxide to that of carbon (44/12). The amount of coal in an average railcar was assumed to be 100.19 short tons, or 90.89 metric tons (Hancock 2001).

Calculation

Note: Due to rounding, performing the calculations given in the equations below may not return the exact results shown.

$$22.68 \text{ mmbtu/metric ton coal} * 25.34 \text{ kg C/mmbtu} * 44 \text{ CO}_2/12 \text{g C} * 90.89 \text{ metric tons coal/railcar} *$$
$$1 \text{ metric ton}/1000 \text{ kg} = \mathbf{191.5 \text{ metric tons CO}_2/\text{railcar}}$$

The EPA's calculator tells us that 16,200 metric tons of CO₂ is equivalent to the CO₂ emissions from burning 85 railcars' worth of coal.

➤ **“Planting enough trees to cover/reforest an area the size of _____”**

Another useful equivalencies provided by the EPA’s Greenhouse Gas Equivalencies Calculator is the carbon sequestered by planting xxx tree seedlings and keeping them growing for 10 years. For a program that weatherizes 500 homes annually, that number is 415,385 trees!

One acre can fit 194 trees planted 15 feet apart,ⁱⁱ so the 415,385 trees would cover 2,141 acres (or about 93 million square feet). Identify a paved-over space of equivalent acreage in your area, such as a nearby shopping center, your city’s downtown, or an abandoned rail yard, that could be hypothetically “reforested.” Use that place’s name to fill in the blank.

➤ **“Taking xxx cars off the road for a year”**

The EPA’s calculator says that 16,200 metric tons of CO₂ is equal to the annual emissions of 2,967 passenger vehicles. For your program, you could say that, over 20 years, the emissions reductions would be equivalent to taking almost 3,000 cars off the road “this year.”

Note: The EOS example of how many cars could be taken off the roads in a metropolitan area requires rather complicated calculations based on survey data we cite. Local agencies can simply state the number of cars that could be taken off the road for a year. You could also say, for example, that this number of cars would fill up the parking lot at a location infamous for its gigantic parking lot) for an entire year, as in either, “Parking these 3,000 cars for a year would require the Civic Center garage / The parking lot at Rose Bush Mall,” or, “Taking that many cars off the road for a year is the same as emptying the Civic Center garage / the parking lot at Rose Bush Mall.”

➤ **“Grounding xxx round-trip flights from L.A. to New York”** - This image cannot be calculated from the EPA’s website. To calculate the number of flights that could be grounded to avoid the CO₂ emissions equivalent to those avoided by your Weatherization program, divide your program’s emissions reductions or 16,200 metric tons by 185 – the average number of metric tons emitted by a NY-LA flight.ⁱⁱⁱ Eighty-eight round-trip Los Angeles to New York flights could be grounded.

You could also calculate the number of flights from your nearest airport to New York, L.A. or some other city that could be grounded by finding the total miles covered by the round-trip flight and plugging in the numbers. For example, a round-trip flight between Columbus, OH and Seattle, WA would produce 152 metric tons of emissions.^{iv} Your program’s emissions reduction of 16,200 metric tons divided by 152 would equal 107 grounded flights between Columbus and Seattle.

Step 4: Find other creative ways to make the CO₂ emissions equivalencies comprehensible and relevant to your target audience.

Relate the examples to your area whenever possible. Try to make the abstract words, “avoided CO₂ emissions” easy for your average reader to understand in positive terms; this usually means illustrating the emissions that WILL happen except for the W.A.P. impact, as it is hard to

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www.weatherizationplus.org

visualize 'absence'. Accompany your text with graphics. Use our graphics if they fit- contact us at info@opportunitystudies.org for the files.

Step 5: Send us your materials; we will post them on the Weatherization Plus website. info@opportunitystudies.org

Equivalencies used for Economic Opportunity Studies' "The Weatherization Assistance Program Reduces Greenhouse Gas Emissions!"

The 32,400,000 metric tons of CO₂ reduced over 20 years by weatherizing 1,000,000 homes is equivalent to:

- The combined annual emissions of the Craig Power Plant (Colorado), Baldwin Power Plant (Illinois), Sam Seymour Power Plant (Texas), and the Capitol Power Plant (D.C.). Source: *Environmental Integrity Project, 2007, Dirty Kilowatts, 2007 Report Database*, http://www.dirtykilowatts.org/Dirty_Kilowatts2007.pdf
- CO₂ emissions from burning 169,191 railcars' worth of coal.. Source: *EPA Greenhouse Gas Equivalencies Calculator*, <http://www.epa.gov/solar/energy-resources/calculator.html>
- Emissions from the jet fuel used in 175,135 round-trip flights between Los Angeles and New York. Source: *DEFRA, 2008 Guidelines to DEFRA's GHG Conversion Factors: Methodology Paper for Transport Emission Factors*. London: Department for Environment, Food, and Rural Affairs, <http://www.defra.gov.uk/environment/business/envrp/pdf/passenger-transport.pdf>
- The carbon sequestered by 491,713,200 medium growth coniferous trees over the first 20 years of their lives. Source: *EPA Greenhouse Gas Equivalencies Calculator*, <http://www.epa.gov/solar/energy-resources/calculator.html>
- The annual emissions of 5,934,066 passenger vehicles. Source: *EPA Greenhouse Gas Equivalencies Calculator*, <http://www.epa.gov/solar/energy-resources/calculator.html>

ⁱ <http://www.epa.gov/solar/energy-resources/refs.html#oil>

ⁱⁱ This number comes from the University of Georgia Warnell School of Forest Resources <http://warnell.forestry.uga.edu/service/library/for96-054/index.html>

ⁱⁱⁱ The UK's Department for Environment, Food, and Rural Affairs (DEFRA) does, however, provide conversion factors for calculating CO₂ emissions from air travel (<http://www.defra.gov.uk/environment/business/envrp/pdf/passenger-transport.pdf>). According to DEFRA, for a medium flight (3-6 hours), a commercial aircraft emits 0.46 pounds of CO₂ per passenger-mile. Calculate an average occupancy of 181 passengers for a commercial aircraft. 4,898 miles is the distance traveled for a round-trip Los Angeles to New York flight (181 x .46 x 4898 = 407,807.48). The total CO₂ emissions per flight is equal to 407,807.48 pounds. Convert this to 185 metric tons (metric tons, sometimes written

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as "Tonne" = 2205 lbs). Pick an airport three hours from your community. Divide 407,807.48 by 2205 = 185 metric tons emitted per flight (jets are very CO2 efficient!).

^{iv} The distance traveled for a round-trip flight between Columbus, OH, and Seattle, WA is 4,020 miles, so, per the above calculation: $181 \times .46 \times 4020 = 334,705.52$ pounds of emissions, or 152 metric tons emitted per flight.