Happy New Year!

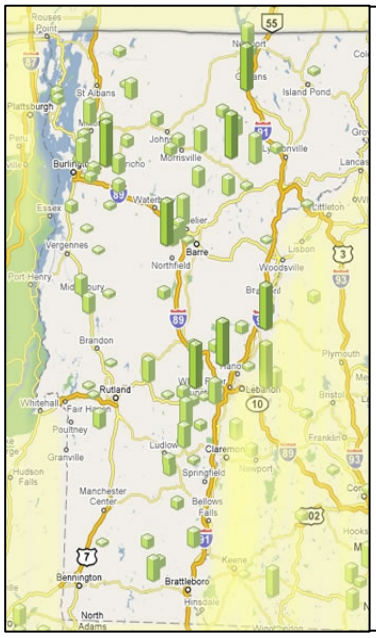
Congratulations and THANK YOU for accepting the Vermont School Carbon Challenge! Your commitment to act puts you in the vanguard of those working to create a more livable and sustainable future...and we at the Vermont Agency of Natural Resources together with the folks at Carbonrally.com and our business partners in this venture sincerely appreciate your efforts. Climate change is clearly a daunting human challenge that requires each of us to do our part. You and your teammates have chosen to help turn the curve in the right direction by reducing your own generation of greenhouse gases. You have, as Gandhi once suggested, "…become the change, you want to see in the world".

As we begin this New Year there are twenty (20) Vermont school teams competing for the $16,000 prize money. Three Vermont school teams are in the top ten nationally (6th, 7th, and 8th places)!

Number of Team Members:	**594**
Number of Challenges Taken:	**2,313**
Number of Tons of CO_2 Reduced:	**50.57**

50 tons (100,000 pounds) of CO_2 is the equivalent of…

- 100,000 balloons, each 2.5 feet wide! (Forty-seven such balloons would fill your living room every day for more than 5.8 years!
- That generated by a 75 watt bulb left on for two hours a day for 555.5 months (or more than 46 years)!
- That generated by watching 200,000 hours of television (or 8,333 days or nearly 23 years)!
- 820,000 cubic feet of CO_2 – or the amount that could be stored in 50,000 average kitchen refrigerators!



This project is made possible by the generous support of our sponsors:

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VT Transco VELCO
BAV Beverage Association of Vermont
BERC Biomass Energy Resource Center
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Cabot
Vermont Sustainable Jobs Fund
Efficiency Vermont

Putting CO_2 into Perspective

- **A single 75 watt bulb burning for two hours a day generates an average of six pounds, or six big balloons, of carbon dioxide a month.**
- **You produce 1/2 lb (pound) of carbon dioxide when you watch television for an hour. You put 20 lbs. (pounds) of carbon dioxide in the air when you burn 1 gallon of gasoline in your car.**
- **One pound of carbon dioxide gas has the volume of 8.2 cubic feet. You could store two pounds of carbon dioxide in the average kitchen refrigerator.**
- **A one-pound CO_2 balloon would be about 2.5 feet wide. Forty-seven such balloons would fill up your living room—every day.**

CONGRATULATIONS…and PLEASE keep up this important work!

PLEASE also consider growing your teams by reaching out to other classes and additional community members. OR…try to get another school in your school district to start a team. It's not too late for new teams to take advantage of this opportunity to join the vanguard of young Vermonters helping to stabilize the global climate. Your efforts matter!

If we at the Vermont Agency of Natural Resources can be of assistance to you in your efforts, please do not hesitate to get in touch with us using the contact information, below:

Vermont Agency of Natural Resources
Department of Environmental Conservation
Office of Environmental Assistance
103 South Main Street, The Cannery
Waterbury, VT 05671-4911
Attn: Doug Kievit-Kylar

Phone 802.241.3628
doug.kievit-kylar@state.vt.us

Thank you for your role as a responsible climate steward!

Jonathan Wood, Secretary
Vermont Agency of Natural Resources

The Carbonrally Team!
Carbonrally.com

Carbon Dioxide in Our Lives

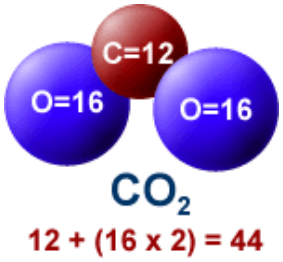
Worldwide, average carbon dioxide emissions per capita are about 6 tons per year. In the U.S., the per capita average is nearer 20 tons per year. Of those 20 tons, about 12 tons come from commercial and industrial sources. The remaining 8 tons come directly from individual energy usage, namely transportation and home energy use. That is about the weight of two full-grown elephants and works out to about 47 pounds of CO_2 a day for every man, woman and child in the country.

Nearly a third of the carbon dioxide emissions generated in the U.S. come from transportation, and of those emissions nearly one-third comes from personal automobiles. Another major contributor of atmospheric CO_2 comes from making the electricity that powers and lights our homes, our schools, and businesses. Coal-fired power plants, which account for half of all electricity generated in the U.S., release roughly 2 billion tons of CO_2 annually while natural gas power plants emit 400 million tons.

The pounds of CO_2 emitted per kilowatt-hour (one hour's use of one kilowatt of energy) vary depending on the type of fuel your utility uses. Coal-fired power plants emit up to 2.49 lbs/kWh while wind, photovoltaic (solar) and other renewable energy sources release less. The national average, combining all energy generation methods, is about 1.34 lbs/kWh.

How to Turn 6 Pounds of Gasoline into 20 Pounds of CO_2

It seems impossible that a gallon of gasoline, which weighs about 6.3 pounds, could produce 20 pounds of carbon dioxide (CO_2) when burned. However, most of the weight of the CO_2 doesn't come from the gasoline itself, but the oxygen in the air.



When gasoline burns, the carbon and hydrogen separate. The hydrogen recombines with oxygen to form water (H_2O), and the carbon recombines with oxygen to form carbon dioxide (CO_2).

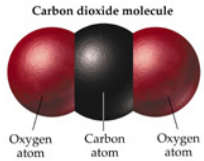
A carbon atom has a molecular weight of 12, and each oxygen atom has a molecular weight of 16, giving each single molecule of CO_2 an atomic weight of 44 (12 from carbon and 32 from oxygen).

Therefore, to calculate the amount of CO_2 produced from a gallon of gasoline, the weight of the carbon in the gasoline is multiplied by 44/12 or 3.7.

Since gasoline is about 87% carbon and 13% hydrogen by weight, the carbon in a gallon of gasoline weighs 5.5 pounds (6.3 lbs. x .87).

We can then multiply the weight of the carbon (5.5 pounds) by 3.7, which equals about 20 pounds of CO_2!

Basic Carbon Dioxide Chemistry



- **Chemical Formula:** CO_2
- **Molecular Weight:** 44.01
- **Boiling Temperature at 1 atm (Atmosphere of Pressure):** Ha! It does NOT boil at one atmosphere.
- **Temperature of Solid CO_2 ("dry ice"):** -78.2° C (195° Kelvin)
- **Common Uses of CO_2:**
  - Refrigeration (dry ice)
  - Fire fighting, fire extinguishers
  - Carbonated beverages (like soda!)
- **Critical Point:** 31° C (304° Kelvin) and 73 atm. (atmospheres) of pressure. Compare this to water. Water has a critical point of 374° C and 22 atm.
- **CO_2 in the Atmosphere:** The Earth's atmosphere is about 360 ppm. (parts per million) carbon dioxide gas. This concentration is an increase from 315 ppm. in 1960.
- **CO2 Production:** You produce 1/2 lb (pound) of carbon dioxide when you watch television for an hour. You put 20 lbs. (pounds) of carbon dioxide in the air when you burn 1 gallon of gasoline in your car.
- **Geometry:** The CO_2 molecule has a linear shape. This means that the atoms in carbon dioxide are arranged like the picture above. The dark circle represents one atom of carbon and the two red circles represent oxygen atoms.
- **One Pound:** One pound of carbon dioxide gas has the volume of 8.2 cubic feet ($ft.^3$). You could store two pounds of carbon dioxide in the average kitchen refrigerator.