

Low Carb[on] Diet: Carbon Reduction Challenge

Hope Allison, Darren Domaracki, Scott Zadig, Jim Woodson



Introduction

The following Carbon Reduction Challenge project implemented by Low Carb[on] Diet consists of four unique strategies: 1) Food Truck Project, 2) Water Heater Reduction, 3) Carbon Intensive Food Reduction, and 4) Hardwood Tree Carbon Sequestration. The goal of this project is to raise awareness concerning carbon dioxide emissions and inspire lifestyle changes within our community.



Food Truck Project



Goal: To provide RockTenn employees with on-campus lunch options and reduce vehicle carbon emissions

Assumptions:

- Average Round Trip: 5.4 miles
- Average Carpool Size: 1.8 persons
- Average MPG: 21.6 miles/gal¹
- CO₂ Emitted per Gallon: 19.66 lbs.

Scalability: Assuming 70 meals sold per week, once a week, at each location:

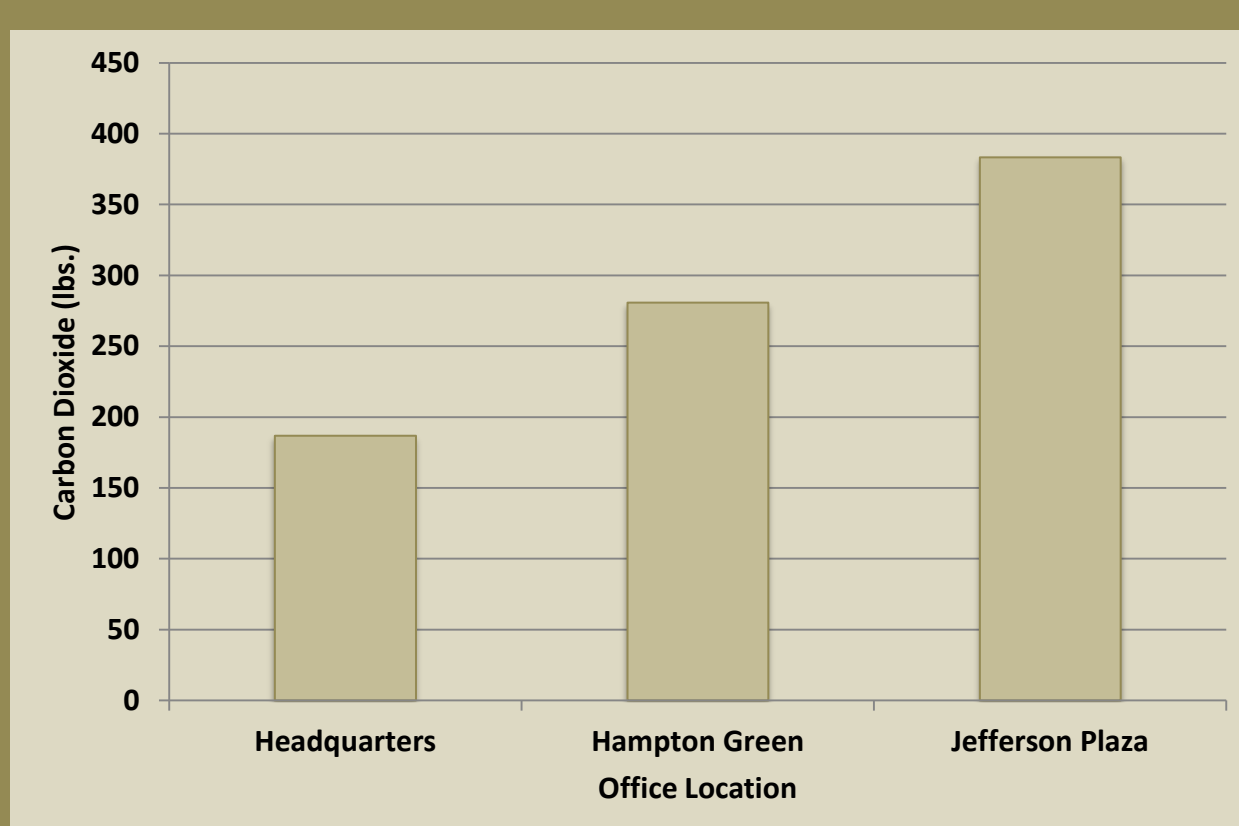
- 1 year: 27,503.52 lbs. of CO₂
- 5 year: 137,517.61 lbs. of CO₂
- 10 year: 275,035.22 lbs. of CO₂

Monetary Savings: Gas Money Saved (\$3.33/gallon) = \$155.86²

Calculation:

Total CO₂ emissions = (Number of Meals) x (Carpool Factor) x (Avg. Miles Traveled Roundtrip) x (Avg. MPG) x (Metric Tons of CO₂ emitted per gallon) x (Ratio of CO₂ to total GHG Emissions) x (2204 lbs/metric ton) - [(Truck Emissions) x (Number of Visits)]

Location	Total Meals Sold	Emissions Saved	Food Truck Emissions	Total Reductions
Headquarters	72	199.65	12.75	186.90
Hampton Green	105	291.15	10.49	280.66
Jefferson Plaza	160	443.66	60.30	383.36
Grand Total				850.92



Water Heater Reduction



Goal: To reduce excessive water heater set points at (3) different houses - ZTA, TKE, and Theta Chi

Assumptions:

- 1 gal raised 1° F = 8.34 BTU³
 - Input Temp. = 60° F
 - 1 gal raised 80° F = 667.2 BTU
- 1 CCF = 748 Gal⁴
- 0.29307 kWh = 1000 BTU⁵
- 1.3 lbs CO₂/kWh⁶

Cost/Benefit:

- Theta Chi – April '12 – '13 Comparison
 - Water consumption increased by 81%
 - Gas consumption remained constant
- Zeta
 - Water increased by \$1.25/day for March
 - Gas usage doubled for March
 - Water constant between April '11-'12

Calculation:

Total CO₂ emissions = Total CO₂ emissions = (Avg. Monthly Gal.) x (30% Hot Water Usage)⁸ x (1 month/30 days) x (BTU/Gal.) x (0.29307 kWh/1000 BTU) x (1.3 lbs CO₂/kWh)

Greek House	Set Pt. (° F)	
	Before	After
TKE	125	115
ZTA (1)	140	115
ZTA (2)	125	115
Theta Chi	125	120

Correction Factor: Assumed same shower temperature is desired despite the water heater reduction⁷

	Correction Factor (% increase)
TKE	4.00
ZTA (1)	1.80
ZTA (2)	7.65
Theta Chi	4.00

	Δ (lbs CO ₂ /Day)
TKE	18.54
ZTA	20.22
Theta Chi	8.80
Grand Total	2,416.00



Carbon Intensive Food Reduction



Goal: To reduce carbon emissions through the reduction of meat and fish consumption

Time-Period: April 3rd – April 30th

Monetary Saving: \$383.85, or \$12.38 per person (31 participants)¹⁹⁻²³

CO₂ Emissions:

- Meat/Fish: 3,291.9434 lbs.
- Replacement Foods: 534.14 lbs.
- Final Reduction: 2,757.80 lbs.

Scalability: An average person contributes the following emissions by consuming beef, pork, salmon, and turkey:

- 1 year: 1,067.54 lbs. CO₂
- 5 years: 5,337.68 lbs. CO₂
- 10 years: 10,675.37 lbs. CO₂

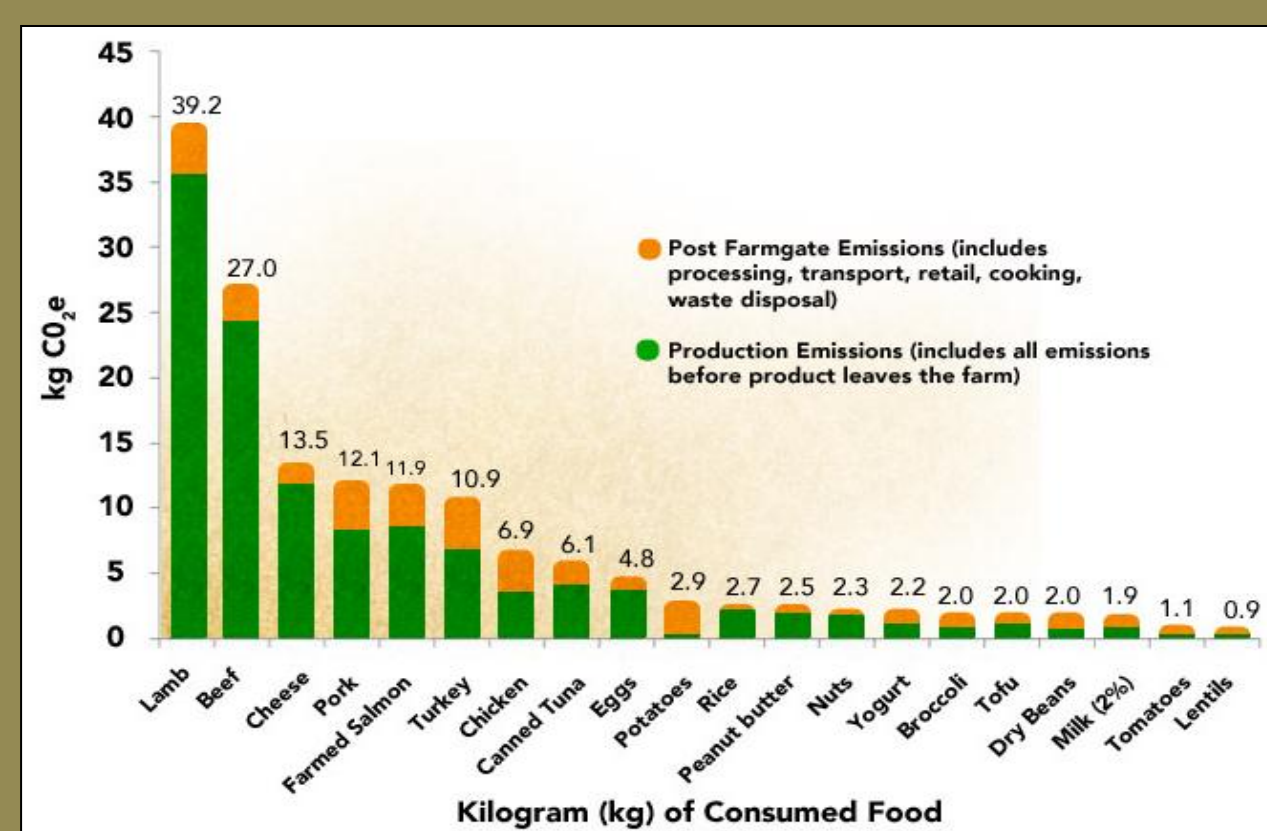


Figure 1: Lifecycle Total of Greenhouse Gas Emissions for Common Protein Foods and Vegetables⁹

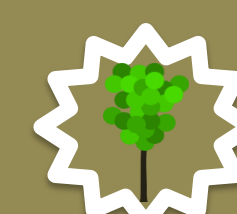
	Beef	Pork	Salmon	Turkey
Total Servings	11.57	11.57	0	3.86
lbs. CO ₂ /4 oz. ¹¹	6.38	3.02	2.97	2.72
Total lbs. CO ₂	77.94	34.93	0	10.49

Replacement Food	Chicken	Tofu	Vegetable/Salad	Fruit	Yogurt
Proportion	32%	13%	24%	10%	21%
Lbs. CO ₂ /4 oz. ¹¹⁻¹⁸	1.721	0.499	0.3275	0.2911	0.248
Total lbs. CO ₂	379.38	44.69	54.15	20.05	35.88

*Note: A grand total of 688.88 servings was reported



Hardwood Tree Carbon Sequestration



Goal: To plant hardwood tree seedlings to offset CO₂ emissions over the lifespan of the tree

Who: Hardwood Forestry Fund – Trees planted by The Army Corps of Engineers¹¹

What: Tree species used include Black Cherry, White Oak, Red Oak, Chestnut Oak, Shagbark Hickory. \$0.50 per tree.¹¹

Where: 65.86 acre lot near Hesston, PA 16647¹¹

Scalability: The entire project taking place in Hesston, PA has a total of 6,600 trees that will sequester 545,777 pounds of CO₂.¹¹

Total Reductions: 16,538.7 lbs. CO₂

Name	Tree Type (H or C)	Growth Rate (S, M, or F)	Number of Trees Planted	Survival Factor	Number of Surviving	Annual Seq. Rate (lb/yr)	Carbon Sequestered
Black Cherry	H	F	40	0.527	21	29.7	626.1
White Oak	H	S	40	0.501	20	8.1	162.3
Red Oak	H	F	40	0.527	21	29.7	626.1
Chestnut Oak	H	S	40	0.501	20	8.1	162.3
Shagbark Hickory	H	S	40	0.501	20	8.1	162.3
Total			200				1739.1

15 Year Projection ⁹	
Year	Carbon Sequestered
0	324.8
1	408.6
2	494.6
3	593.0
4	688.8
5	784.3
6	891.7
7	991.0
8	1,096.7
9	1,189.0
10	1,284.3
11	1,378.9
12	1,467.5
13	1,559.8
14	1,646.6
15	1,739.1
Grand Total	16,538.7



Conclusion

Total Emissions Reduced: **22,563.42 lbs. CO₂**

- Equivalent to the amount saved by not burning 1,148 gallons of gasoline or 1000 gallons of diesel fuel
- Equivalent to the amount of CO₂ emitted every 2 minutes from a 500 MW coal-fired power plant
- Equivalent to the amount of CO₂ emitted to produce 11,110 kWh from bituminous coal

References

- 1 EPA (2013). *Calculations and References*. <<http://www.epa.gov/cleanenergy/energy-resources/refs.html>> Accessed April 2013
- 2 Georgia Gas Prices (2013). *Lowest Regular Gas Prices*. <<http://www.georgiagasprices.com/>> Accessed April 2013
- 3 University of Illinois (2010). *Smart Energy Design*. <<http://www.smartenergy.illinois.edu/>> Accessed Feb 2013
- 4 City of Atlanta (2011-2013). *Water Bills*. Accessed April 2013
- 5 American Physical Society (2013). *Energy Units*. <<http://www.aps.org/policy/reports/>> Accessed April 2013
- 6 EPA (2009). *Summary Tables*. <<http://www.epa.gov/cleanenergy/>> Accessed April 2013
- 7 Energy Star (2007). *Water Heating*. <<http://www.energystar.gov/>> Accessed April 2013
- 8 Minor, G., et al., (2013). *Industry Source*. Accessed February 2013
- 9 U.S. Department of Energy, Energy Information Administration. (1998). *Method for Calculating Carbon Sequestration by Trees In Urban and Suburban Settings*. <<ftp://ftp.eia.doe.gov/pub/oi/af/1605/cdrom/pdf/sequester.pdf>> Accessed April 2013
- 10 <http://www.hardwoodforestryfund.org>
- 11 <http://www.ewg.org/meateatersguide/a-meat-eaters-guide-to-climate-change-health-what-you-eat-matters/climate-and-environmental-impacts/>