Tracking and Reducing Emissions from Food at PLU

Saiyare Refaei

Sustainability Fellowship 2012-2013

Table of Contents

Acknowledgements

I would like to give special thanks to my advisors, Dr. Charles Bergman and Wendy Robins for their guidance and support. Thank you to Dr. Anna Leon-Guerrero for her help devising and analyzing the student survey. I want to acknowledge my partnering fellows, Tyler Wilson and Kenneth Stancil, as well as the rest of the PLU Sustainability Committee for their support. Thanks to Doug Hinners, Amber Wilson, Seth Vidana, Samantha Meyer, Thomas Koerner and Ron DeSantic for taking the time to talk with me about their dining and sustainability programs. Thank you to PLU Dining & Culinary Services for their assistance with this project. Additional thanks to Chrissy Cooley (PLU Sustainability Department), Dr. Sheri Tonn (PLU Office of Finance and Operations, Dr. Claire Todd along with Jan Lewis and Lisa Henderson (PLU Office of the Provost) for making it possible for me to attend and present a poster of this information at the 7th Annual Future of Food and Nutrition Conference at Tufts University in Boston on April 6th, 2013.

Understanding the ACUPCC, PLU's carbon footprint and the missing meat of the problem

Former Pacific Lutheran University's President, Loren Anderson was one of twelve founding signatories of the American College & University President's Climate Commitment (ACUPCC) in 2007 to carry out a long term plan to establish Leadership in Energy and Environmental Design (LEED) buildings, renewable sources of energy, better waste management strategies, carbon offsets from travel miles and ENERGY STAR certified appliances to make the university carbon neutral as soon as possible. (ACUPCC "Mission"; ACUPCC "Text") Pacific Lutheran University has been committed to finding more energy saving and sustainable avenues after signing the ACUPCC in 2007, resulting in the greater goal of being a carbon neutral campus by December 31, 2020 (Gregg 6). The ACUPCC fails to recognize the number one source of green house gas emissions: industrial meat production and the agricultural sector. The impact of food (especially meat) consumption on college campuses as a major source of energy, green house gas emissions and exploiter of natural resources needs to be addressed in order to attain the goal of becoming a carbon neutral campus.

In partnership with McKinstry, Pacific Lutheran University tracked the university's carbon emissions in 2009 (PLU "Emission") and produced their "Climate Action Plan & Sustainability Guide." The report summary shows PLU Carbon emissions totaling to 14,804 Metric Tonnes (tons) Carbon Dioxide Equivalent (MTCDE). MTCDE is the standard measurement of the carbon dioxide equivalent of green house gasses. The emission summary described Air Travel from study away programs and business trips as the highest emitter recorded at 6,182 MTCDE or 42% of the total emissions. The second greatest emitter was On-Campus Stationary surmounting to 3,812 MTCDE or 26% of the total emissions. Campus commute amounted to 3,940 MTCDE (23%), On-Campus Purchased Electricity was 574 MTCDE (4%), Mobile combustion was 121 MTCDE (1%) and 4% of PLU's total carbon equivalent emissions came from solid waste (Gregg 6). Though electricity and waste output contributes to a part of the Dining & Culinary Services energy use, this report does not take into account the energy it took to produce and transport the food consumed on campus.

The Department of Dining & Culinary Services at PLU has really stepped on board to make sustainability part of their mission as stated on their website: "We are focusing resources towards cutting down to zero-waste through the Green Tray Program, helping students organize their waste as trash, compost or recycling." (PLU Dining) Doug Hinners, the PM Sous Chef at PLU, informed me that the vegetable trimmings are turned into homemade vegetable broth and chicken backs,

otherwise not eaten, are utilized to make homemade chicken broth before they are composted. The Dining staff is committed to finding more sustainable products and improving their composting and recycling strategies. They have stopped selling bottled water in the campus dining hall and stores after a student-led initiative in 2011 and support Meat Free Mondays by allocating the Cross Cultures food station in The Commons as a vegetarian option every Monday. They are always incorporating more vegetarian friendly alternatives throughout the week. Each vegan, vegetarian and gluten-free option, along with all of the dishes containing potential allergens such as tree nuts and fish, are carefully labeled according to the Restricted and Alternative Diets (RAD) symbols.[1] When purchasing food, Dining & Culinary Services also seeks out locally grown and humanely treated sources to reduce transportation miles and emissions but also for more ethical and social justice reasons. Dining & Culinary Services locally sources the shell and liquid eggs that are grown cage-free on Steibrs Farm in Yelm, Washington. All of the chicken breasts used in the side salads at Good Things, on the pizza at Aglio and as a side dish at the salad bar are free-range and humanely raised from Draper Valley Farms in Mt. Vernon, Washington. Milk served in The Commons is recombinant bovine growth hormone (rBGH) free. The seafood is purchased according to Monterey Bay Aquarium's Seafood Watch guidelines for sustainability and they sell the excess fryer oil to Standard Biodiesel to be converted into renewable diesel (PLU Dining). According to Hinners, Dining is working hard to connect with other local food providers such as Zestful Gardens that is only 20 miles away and Cheryl the Pig Lady, as well as more sustainable meat options such as rabbit and capon (rooster), to provide more local and sustainably grown food. According to Hinners, Dining feels more comfortable communicating with local growers that they personally know versus their sales representative who wants them to buy more of that particular product. The local producers truly care about the integrity of their product to keep their small business afloat. Hinners' biggest mission is to seek out and provide more locally grown and seasonal produce because, "Eating things out of season has a heavy cost on ourselves and the environment."

Pacific Lutheran University is doing a wonderful job emphasizing sustainability, meeting standards of Leadership in Energy and Environmental Design (LEED) for more buildings, reducing waste outputs by composting and recycling, utilizing more energy-efficient resources, and having a Sustainability Office and Sustainability Committee dedicated to finding more ways to make PLU

[1] These symbols can be found on the Dining website under "Allergies & RAD" at http://www.plu.edu/diningandculinary/Allergies/home.php

more sustainable. Yet the ACUPCC and PLU's emission summary do not accurately include the emissions consumed (directly and indirectly) in the food consumed at the university. Conducted with full support and indispensible help from Dining & Culinary Services, this study also attempts to quantify these emissions with the purpose of incorporating these figures to understand and develop accurate and effective strategies to meet the President's Climate Commitment of a carbon neutral campus by 2020.

Including food and meat consumption into our sustainability efforts is important because, as stated in the Food and Agricultural Organization of the United Nations' report in 2006 titled *Livestock's Long Shadow*, meat is "responsible for 18 percent of greenhouse gas emissions measured in CO_2 equivalent. This is a higher share than transport" (Steinfeld xxi). I have been inspired to find a way to calculate the carbon emission equivalent to our food, and especially meat, consumption on campus as a way for PLU to address this section of its ecological footprint.

What is Climate Change?

The effort to become a carbon neutral campus is a direct response to the adverse consequences of global climate change (sometimes referred to as global warming). The effects of climate change are some of the biggest issues that humanity will face within our lifetime. Anthropogenic climate change, or climate change resulting from human actions, has proven to have adverse effects on the atmosphere's composition. Climate change is observed through the greenhouse effect that regulates the atmospheric temperature and according to the FAO 2006 report: "Without it, the average temperature of the earth's surface would not be 15°C but -6°C" (Steinfeld 80), or 59° F but 21.2° F. The earth has witnessed an increase of anthropogenic emission concentrations since the beginning of industrialization. The earth's average surface temperature has risen 0.6° C or about 1° F since 1970 and is projected by the Intergovernmental Panel on Climate Change to increase by 6° C or 11° F this century (Brown 6)[2].

[2] See original sources: Saobing Peng et al., "Rice Yields Decline in Higher Night Temperature from Global Warming," *Proceedings of the National Academy of Sciences*, 6 July 2004, pp. 9,9971-75; J. Hansen, NASA's Goddard Institute for Space Studies, "Global Temperature Anomalies in 0.1 C," at data.giss.nasa.gov/gistemp/tabledata/GLB.Ts.txt, updated April 2009; "Summary for Policymakers," in Intergovernmental Panel on *Climate Change, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), p. 13.

Greenhouse gases that naturally compose the earth's atmosphere include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3). Since the pre-industrial era, before around 1750 to 2010, the concentration of these greenhouse gases has increased on a global level by 39 percent, 158 percent and 19 percent (EPA Summary 4). More recently emissions in the United States increased 10.5 percent in the two decades between 1990-2010, and 3.2 percent in the two years between 2009 and 2010 (EPA Summary 4).

When we talk about global warming, we mostly hear about carbon dioxide missions as we well should, because 76.7 percent of all man-made greenhouse gas emissions are carbon dioxide (Lappé 7)[3]. According to the United States Department of Agriculture Economics Research Study conducted in 2007 as mentioned in Anna Lappe's *Diet for a Hot Planet: The Climate Crisis at the End of Your Fork and What You Can Do About It*, "When asked about the primary cause of increases in the earth's temperatures, only 53 percent of Americans, the lowest number among all the populations surveyed, answered correctly that it was the increased levels of carbon dioxide in the atmosphere. Nearly one third of Americans thought that global warming was caused by an atmospheric 'ozone-hole'; 7 percent thought it was caused by increased out-put from the sun, and 8 percent assumed it was because of the earth's orbit" (Lappé 62)[4]. Ultimately, climate change results in more severe and extreme variability and natural events. It is projected that 15 to 37 percent of all species will be threatened with extinction because of climate change (Steinfeld 80)[5].

The Run-Down of Emissions Pertaining to the Meat Industry

The President's Climate Commitment and PLU's Climate Impact Assessment focus on green house gas emissions to attain carbon neutrality by 2020. It is important to then understand the role the food industry and emissions from the agricultural and meat industries (especially livestock) have on a global and national scale. As of the 2009 Worldwatch Institute report, 32 billion tons of carbon dioxide per year or 51 percent of the entire human caused green house gas emissions

---

[3] The original source is located at: IPCC, *Climate Change 2007: Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press, 2007: graphic 13.5.

[4] Please see the original source at: USDA ERS. "Food Security in the United States," 2007, Available at: http://www.ers.usda.gov/briefing/foodsecurity.

[5] For the original source see: Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., Ferreira de Siqueira, M., Grainger, A., Lee Hannah, Hughes, L., Huntley, B., van Jaarsveld, A.S., Midgley, G.F., Miles, L., Ortega-Huerta, M.A., Peterson, A.T., Phillips, O.L. & Williams, S.E. 2004. "Extinction risk from climate change." *Nature* 427: 145-148.

resulted from the world's 1.5 billion livestock (Darragh; Imhoff xvii)[6]. As already stated, the FAO's 2006 report calculated that the livestock sector accounts for 18 percent of the green house gas emissions measured in the CO_2 equivalent (Steinfeld xxi); and as mentioned by co-author of the report Henning Steinfeld in the 2007 documentary *Meat the Truth* this 18 percent figure is "taking into account the change in land use due to livestock, production of animals with methane, manure management with methane and oxides, various parts of livestock production and transportation that deal with feed commodities" (Thieme). After carbon dioxide, the other top emissions from the agricultural and livestock sector are emitted in the form of methane, nitrous oxide and ammonia. A more detailed discussion of these three gaseous emissions and their impact are included in Appendix A starting on page 28 of this report.

As author Jonathan Safran Foer says in *Eating Animals*, "Animal agriculture makes a 40% greater contribution to global warming than all transportation in the world combined; it is the number one cause of climate change"(Foer 43). However there are other sources that don't see the whole process of animal production for food as the number one cause of climate change. When it comes to climate change pollution, NASA determined that automobiles are the largest net contributor followed by the burning of household biofuels such as wood and animal dung and raising livestock (Shahan), yet based on all of these other studies one could speculate otherwise. According to Derek Markham's "Global Warming Effects and Causes" Top 10 list:

- the number one cause of global warming are from carbon emissions from fossil fuel burning power plants;
- the second are carbon dioxide emissions form burning gasoline for transportation;
- the third, methane emissions from animals;
- the fourth, deforestation and
- the fifth is an increase in chemical fertilizers on crops. (Markham)

Yet one might be skeptical of Markham's list because all of his top 5 causes for climate change involve the agriculture or livestock sector in one way or another. If you look at the whole picture, the livestock sector accounts for much more. According to the FAO's report, 9 percent of the anthropogenic CO_2 emissions, 37 percent of the anthropogenic methane (with 21 times the global warming potential [GWP] as CO_2), 65 percent of the anthropogenic nitrous oxide (301 times the

[6] For original sources see: Robert Goodland and Jeff Anhang, "Livestock and Climate Change: What If the Key Actors in Climate Change are…Cows, Pigs, and Chickens?" *World Watch Magazine*. November/December, 2009: 10-19.

GWP of CO_2) and two-thirds (64 percent) of the anthropogenic ammonia emissions are due to the livestock sector (Steinfeld xxi; EPA Summary 3, TABLE ES-1).

The Free University of Amsterdam and the Nicolaas G. Pierson Foundation calculated the environmental impact Americans would have if they reduced their meat consumption: if all Americans ate vegetarian for 7 days it would save 700 megatons of green house gas emissions, which is the equivalent of taking of all the cars on the road in the U.S.; if all Americans ate vegetarian for 6 days it would be the same as eliminating all household electricity use in the U.S.; if all Americans ate vegetarian for 5 days, that would be like planting 13 billion trees and letting them grow for 10 years, that's 4 trees per American; if all Americans ate vegetarian for 4 days, it would cut the domestic use of electricity, gas, oil, petrol and kerosene in the U.S. in half; if all Americans ate vegetarian for 3 days, it would cut our 300 megatons of green house gas emissions, which is a greater impact than if all of the cars in the U.S. were replaced with Toyota Priuses; if all Americans ate vegetarian for 2 days that would be the same as replacing all of the household appliances with energy efficient ones in the U.S.; and if Americans ate vegetarian for just 1 day that would be the same as eliminating 90 million plane tickets from Los Angeles to New York or New York to Los Angeles (Thieme).

The Environmental Impact of Animal Feed

Even though the concentration of this investigation is to understand the impacts of meat and calculating green house gas emissions, it's also very important to emphasize that the meat industry has a greater role in the environmental degradation, especially the degradation of fundamental components to sustain life on this planet: air, soil and water. Meat may be the issue at hand yet the root of the problem may actually be corn and the other types of feed that animals, now mass-produced, are being fed.

Companies such as Monsanto have genetically modified corn and many other seeds so that they are resistant to their pesticides; these patented seeds are subsidized by the federal government, enabling them to be produced for far less than it takes to grow them. Researchers at Tufts University estimated that in the United States alone, the industrial animal sector saved more than $35 billion from 1997 to 2005 due to federal farm subsidies that lowered the price of feed

(Imhoff 67)[7]. This amounted to an estimated $3.9 billion saved per year on corn and soybeans for factory farmers (Imhoff 68)[8].

As corn, soybeans, alfalfa sprouts and other feed items are genetically modified and mass produced at below market prices, production rates have increase to the point where these crops are force fed to farm animals that wouldn't normally eat them. The family farm thus expanded into *concentrated animal feeding operations* (CAFOs), *intensive livestock operations* (the term used in Canada), and the smaller, *animal feeding operations* (AFOs) (Imhoff xv). Imhoff writes, "By current U.S. Environmental Protection Agency definitions, a large CAFO imports its feed and concentrates more than the following: 1000 cattle; 2,500 swine over 55 pounds; 10,000 swine under 55 pounds; 55,000 turkeys; 125,000 chickens; or 82,000 laying hens" (Imhoff xv). In 1970, four meatpacking firms slaughtered 21 percent of the nation's cattle; now 84 percent of cattle slaughtered in the U.S. are by Congra, Iowa Beef Processors (IBP), Excel or National Beef (Schlosser 137-138). When it comes to chicken production, there are eight leading producers controlling two-thirds of the market, with more than half of the chicken in the U.S. being raised in Alabama, Arkansas, Georgia and Mississippi (Schlosser 139). According to Imhoff, the Union of Concerned Scientists says the CAFO industry's rapid expansion is due to:

> "(1) Subsidy programs that have allowed large producers to lower operating costs by buying discounted grains; (2) innovations in breeding that produce animals tailored to harsh confinement conditions; (3) increasing use of antibiotics to thwart disease; (4) the ability of CAFOs to avoid costs of safe manure treatment and handling; (5) lack of enforcement of existing antitrust and environmental regulations; (6) the domination of markets through contracts and ownership; and (7) the disregard of the negative effects of concentrated production on people living near the facilities." (Schlosser 195)[9]

The Union of Concerned Scientists also states "U.S. taxpayers shell out at least $7 billion to subsidize or clean up after CAFOs with an additional $4.1 billion spent over the years to control leaking manure storage facilities" (Imhoff 220)[10].

---

[7] Please see the original source at: Doug Gurian-Sherman, *CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations*. Cambridge: Union of Concerned Scientists, April 2008: 18.

[8] The original source is: Elanor Starmer and Timothy A. Wise, *Feeding at the Trough: Industrial Livestock Firms Saved $35 Billion from Low Feed Prices*, Policy Brief No. 07-03. Medford, MA: Tufts University Global Development and Environment Institute, December 2007: 1.

[9] Please see the original source: Doug Gurian-Sherman, *CAFOS Undercovered: The Untold Costs of Confined Animal Feeding Operations*. Cambridge, MA: Union of Concerned Scientists, April 2008: 17-20.

[10] Please also see: Doug Gurian-Sherman, *CAFOS Undercovered: The Untold Costs of Confined Animal Feeding Operations*. Cambridge, MA: Union of Concerned Scientists, April 2008.

Assume that a cow consumes twenty-five pounds of a corn-based diet daily until it reaches twelve hundred pounds. In its lifetime, that cow will also consume the equivalent of thirty-five gallons of oil to produce its feed (Pollen 83), equating to more than 80 percent of a full barrel of oil in its lifetime. Producing one pound of beef requires 13 pounds of feed; for one pound of pork, 5.9 pounds of feed; and for one broiler chicken, 2.3 pounds of feed (Imhoff 67)[11]. Even farmed fish are beginning fed corn and other commodities that they wouldn't normally eat in nature. According to the FAO 2006 report, the demand for fish has increased because fish is also being fed to livestock. As estimated in 2004, fishmeal and fish oil for livestock feed made up 24.2 percent of the world fishery production (Imhoff 205-206)[12]. Let us not forget that seafood, though it is not the focus of this investigation, plays its own role in environmental degradation. Take for instance shrimp. Modern methods for catching shrimp include *trawling*, which scrapes the ocean floor of any and all in its way. Shrimp accounts for 2 percent of global seafood by weight yet accounts for 33 percent of global bycatch; in other words a package of shrimp should really say: "26 POUNDS OF OTHER SEA ANIMALS WERE KILLED AND TOSSED BACK INTO THE OCEAN FOR EVERY 1 POUND OF THIS SHRIMP" (Foer 49; capital letters in the original).

Not only are these genetically modified crops guzzling oil, their ever-growing production literally depends on tons of herbicides, insecticides and fertilizers. Farmers are only producing 370,000 acres of the 70 million acres of corn grown in the United States for human consumption and 98 percent of these 70 million acres are then treated with 70 thousand tons of herbicide and 30 percent treated with insecticide (Imhoff 184; Steinfeld 158)[13]. What happens to all of these chemicals that are not absorbed by the plants themselves? If the chemicals are not emitted back into the atmosphere, absorbed in the soil or in runoff from leaching, then they are absorbed in the fatty tissue of smaller organisms through a process called *bioconcentration* and they gain in higher concentrations as they move up the food chain in *biomagnification* that ultimately impacts the

---

[11] The original source is: Doug Gurian-Sherman, *CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations*. Cambridge, MA: Union of Concerned Scientists, April 2008: 18.

[12] The original source is: Vannuccini, S. "Overview of fish production, utilization, consumption and trade." Fishery Information, Data and Statistics Unit, FAO. 2004: 20.

[13] For original sources also see: USDA."Vegetable Report." April 2009; *Agricultural chemical use*. National Agricultural Statistics Service/USDA Economics and Statistics System, 2001.

longevity of wildlife populations and can lead to cancers, compromised immune systems, tumors, altered reproductive systems and birth defects in animals and humans (Steinfeld 158)[14].

A substantial contribution of the pesticides used on crops grown in industrial agricultural for animal feed result in one of the biggest environmental issues facing the United States: soil erosion. "In the last 200 years, the United States has probably lost at least one-third of its topsoil" (Steinfeld 73)[15]. According to the 2006 FAO report:

> About 7 percent of the agricultural land (2001) in the United States is devoted to the production of animal feed. Livestock production can be said to be directly or indirectly responsible for a significant proportion of the soil erosion in the United States. A careful assessment of erosion on crop and pasture lands suggests that livestock are the major contributor to soil erosion on agricultural lands, accounting for 55 percent of the total soil mass eroded every year. (Steinfield 73)

As history has already shown us, the 1931 corn harvest replacing 250 million bushels of prairie grass enabled the Great American Dust Bowl the following year to strip away an inch of soil, which took a millennia to create, in a single hour (Fussel 281).

Animal feed takes a lot of water to grow. Irrigation for agriculture makes up 94 percent of ground water use and produces one-fifth of the wheat, cotton, corn and cattle in the U.S. (Kromm). Humans may only need 4 liters of water a day while industrial agriculture in the United States needs 2,000 liters of water a day to meet our food requirements (PEW 5)[16]. The author of *The Food Revolution*, John Robbins estimated that " you'd save more water by not eating a pound of California beef than you would by not showering for an entire year" (Motavalli).

Looking back at livestock, much of the sector is now dependent on other countries to raise the cattle that are then sent to the United States for slaughter, distribution and eventually consumption. The FAO estimates that 70 percent of forest cover in Latin America has been converted to grazing land (Walsh). Cattle ranches result in 65 to 70 percent of the deforestation in the Amazon Rainforest (Butler). As Betty Fussell writes in *Raising Steaks*, "We would have to think twice about destroying two-fifths of the world's remaining rainforest in the Amazon with 50 million cattle" (Fussell 280-281).

---

[14] The original source is: Ongley, e.d. "Control of water pollution from agriculture." *FAO Irrigation and Drainage Paper* no. 55. Rome: FAO, 1996.
[15] See original source: Barrow, C.J. *Land degradation: Development and breakdown of terrestrial environments*. UK: Cambridge University Press, 1991: 313.
[16] See the original source: Brown, L.R. "Plan B 2.0." W.W. Norton and Company: New York, 2006.

With increasing populations and ever-growing demands for meat, the true cost of meat and the methods by which it is produced and slaughtered are still unknown to the vast majority of the global population. Meat production has altered so dramatically that chickens that once took 85 days in 1950 to reach 5-pounds now take only 45 days (PEW 5)[17]. If you don't want to be spared the gory details and expand your knowledge of the meat industry further, then it is highly recommended that you read one or more of the following: *Eating Animals* by Jonathan Safran Foer, *The CAFO Reader: The Tragedy of Industrial Animal Factories* by Daniel Imhoff and *Every Twelve Seconds: Industrial Slaughter and the Politics of Sight* by Timothy Pachirat. As Michael Pollen writes in *The Omnivore's Dilemma: A Natural History of Four Meals*, "The meat industry understands that the more people know about what happens on the kill floor, the less meat they're likely to eat. That's not because slaughter is necessarily inhumane, but because most of us would simply rather not be reminded of exactly what meat is or what it takes to bring it to our plates" (Pollen 304).

What is horrifying is that the meat industry is now passing laws to prevent the public from knowing about what goes on inside the CAFOs and slaughterhouses. This very year under corporate pressure, Iowa passed HF 589 also known as the "Ag Gag" law, criminalizing those who take any action to speak out against factory farms and slaughterhouses; after many journalists and animal rights activists posing as workers released undercover videos that have resulted in mass recalls and slaughterhouse closures (Carlson). You may also remember that in April of 1996, Oprah Winfrey and Howard Lyman were sued under a Texas libel law because they spoke out against beef in the midst of the mad cow outbreak, resulting in major profit losses for the industry (Thieme; CNN U.S.). Winfrey and Lyman won their battle in Texas, but it is evident that many more similar laws are pending due to corporate pressure in other states truly demonstrating the power of the industry.

If we consider emissions produced from the food industry in general, the transport of imported produce from other states has a forty-five percent greater impact versus local produce, while food that is air freighted has a five hundred percent greater impact on global warming (Lappé 220)[18]. Even if the 16 million acres in the United States now used to grow corn for cattle feed were turned into well-managed pasture, this would remove 14 billion pounds of carbon from the atmosphere annually, which is the same as removing 4 million cars from the road (Pollen 197).

---

[17] The original source is: HSUS. "The Welfare of Animals in the Broiler Chicken Industry." Washington D.C.: HSUS, 2006: 1-7.

[18] See original source: National Resources Defense Council. "Food Miles: How Far Your Food Travels Has Serious Consequences for Your Health and the Climate." Washington, D.C.: NRDC, 2007.

Even if feed was switched to organic methods of production, organic corn uses one-third less energy per acre saving an estimated sixty-four gallons of fuel an acre (Lappé 208)[19]. There are many measures that should and need to be taken in order to reduce the overall environmental impact of food and especially meat production worldwide.

Pacific Lutheran University, and all universities for that matter, should take on the responsibility to educate their students, staff and faculty about the greater impacts of the food they choose to eat. Universities provide the basic foundation for students to take away life-long knowledge and practices. Therefore, universities also have the responsibility to provide and advocate for sustainably produced food.

Benefits of eating less meat and industrial meat alternatives

With a basic understanding of the real impacts of industrial meat production, there are avenues to significantly reduce Pacific Lutheran University's carbon footprint from meat; the produce provided and the consumer's choice is where the greatest impact lies. Environmental Defense, a prominent American group, recently stated on their website: "If every American replaced chicken with vegetarian foods in just one meal per week it would be the equivalent of carbon dioxide about taking 500,000 cars off the U.S. roads" (Thieme). If we want to make an environmental difference, consider that: "Beef production alone uses more water than is consumed in growing the nation's entire fruit and vegetable crop," or that "producing a single hamburger patty uses enough fuel to drive 20 miles and causes the loss of five times its weight in topsoil" (Motavalli). Claude Albert of the Agricultural Engineers' College of Higher Education estimates "that beef production contributes twenty to thirty times more to climate change that the production of the same amount of protein in the form of legumes" (Imhoff 246-247)[20].

There are many sustainable methods of reducing one's environmental impact from meat consumption; there are more sustainable methods of meat production from which to choose from. It may take some research on the consumer's part but knowing where one can find local sources of

---

[19] The original source is: David Pimentel, *Impacts of Organic Farming on the Efficiency of Energy Use in Agriculture*. Ithaca, NY: Organic Center, 2006: 9.

[20] See the original source: Claude Albert. "Impact of the Food Production and Consumption on Climate Change." paper presented at the International Conference on Organic Agriculture and Global Warming. Ferrand, France: 17-18 April, 2008.

meat and grass fed beef or humanely raised chicken will be more beneficial to the environment and their own health in the long run. A study by the Humane Society's Danielle Nierenberg and Gowri Koneswaran found that even "organic beef can emit as much as 40 percent fewer greenhouse gases and require 85 percent less energy than confined feedlot beef" (Lappé 74)[21].

When it comes to our health, Americans have already been making the trend to reduce their meat intake. It is projected that "Americans are expected to eat 12 percent less meat and poultry than they did five years ago," and those under the age of 30 and above 65 years old are finding more high-protein alternatives to meat such as tempeh, tofu, lentils, eggs, quinoa, nuts, fish and shellfish mostly for health purposes (Ketzenberger). Americans now consume 200 pounds of meat, poultry and fish per person each year; our meat intake has increased by 50 pounds in the last 50 years (Bittman). Each American is consuming approximately 110 grams of protein per day, which is twice the government's recommended allowance, with 75 grams coming from animal protein (Bittman). Meat isn't the only good source for protein and other essential nutrients as Peter Singer writes in *Animal Liberation*:

> An acre of broccoli produces twenty-four times the same amount of iron. …Oats produce more than twenty-five times as many calories per acre as beef. …Although milk production does yield more calcium per acre than oats, broccoli does better still, providing five times as much calcium as milk. (Singer 166)[22]

Though these alternatives may cost more at the super market or at a local farm than going out for fast food and buying low-priced industrial produced meat, with each sustainable purchase the cost on our health and the environment will significantly be reduced. When it seems that industries hold all the power and devise shortcuts to produce more of their product at a cheaper price, it is based upon the consumer's demand. If we begin to buy food at its true cost for all of these reasons stated above, the industries will change for the better to meet our demands. If universities such as PLU begin to understand the true impact of the food they purchase and provide, then they can then begin to strive for more sustainable alternatives.

---

[21] For more information, see: C Cederberg et. al. "System Expansion and Allocations in Life Cycle Assessment of Milk and Beef Production." *International Journal of Life Cycle Assessment*. vol. 8, 2003: 350-356; D. Fanelli. "Meat is Murder on the Environment." *New Scientist*. 18 July, 2007: 15.Web. http://environmental.newscientist.com/article.ns?id-mg19526134.500&feedId=online-news_rss20; A. Ogino, "Evaluating Environmental Impacts of the Japanese Beef Cow-Calf System by the Life Cycle Assessment Method." *Animal Science Journal*. vol. 78. 2007: 424-432.

[22] The original source is: Keith Akers. *A Vegetarian Sourcebook*. New York: Putnam, 1983: 90-91.

PLU Food Emissions

According to Hinners, salmon at PLU comes from a sustainable source, the lamb they buy is humanely raised but it is shipped in from New Zealand and the biggest weaknesses within the area of meat are the sources for beef and chicken. However, Dining have been trying to find other sustainable sources. For instance, they switched from buying white breast meat normally used in dishes like fajitas and have gone to thigh meat that is more flavorful, less expensive and has more flexibility to be used in other dishes. They have also started to buy cuts of beef that are more versatile and less expensive because they come in greater quantities.

The heart of this project is to determine how PLU, as an educational university, can target the issues of food injustices imposed by industry production methods and track its progress to become carbon neutral by 2020. By calculating the emissions from food consumption using Clean Air-Cool Planet's online Charting Emissions from Food Services (CHEFS) program, PLU can begin to determine which foods put off the highest amount of metric tons of carbon dioxide equivalent emissions as they search for more local and sustainably produced food. Once emissions have been calculated at PLU these figures can be incorporated into PLU's Presidents' Climate Commitment to become carbon neutral by 2020 so that the energy that each individual on this campus consumes will be figured into this greater goal.

Dining & Culinary Services provided the information to be in putted into the CHEFS online program. The crucial information needed to successfully calculate emission figures through the CHEFS program include the food type, the amount purchased in pounds, and the miles transported to campus. The optional information to input include: brand, a user note, to the warehouse information including the type of agriculture (traditional, organic, IPM or integrated pest management, Free-Range, and Cage-Free), processing methods (low, medium, high), transportation method (dry, refrigerated, frozen, air), and storage (low, medium, and high). The food information Dining provided enabled me to input the following food items into the program: chicken breast, breaded chicken tenderloin, chicken wings, frozen beef patties, liquid eggs, tofu (the numbers found correspond to the pounds of soybean that it takes to make the tofu because tofu wasn't a category on the CHEFS' website), and spinach (cellos fresh and frozen). One setback of the CHEFS' site is that not all of the food categories are on their list.

Based on the website *Tofu's Carbon Footprint*, written by freelance writer Tiffany Plate, her standard was used to figure out the equivalent amount of soybeans needed to make all of the tofu consumed at PLU. One pound of tofu is the same as 0.005 bushels of soybeans and one bushel contains approximately 60 pounds of soybeans. This means, to make one pound of tofu one needs 0.45 pounds of soybeans. By multiplying this number to the pounds of tofu one calculates the carbon footprint of the soybeans needed to produce the same pound in tofu. The total pounds of tofu consumed during the last budget year at PLU is 989 pounds, which means 445.05 pounds of soybeans where needed to make all that tofu.

One of the most astonishing figures, just looking at the comparison of Draper Valley Farms chicken from Mt. Vernon, Washington, and chicken processed by Tyson Foods in Arkansas. The more than 18,500 pounds of chicken breast from Draper Valley, located about 104 miles away from PLU, while the 3,220 pounds breaded chicken tenderloin, (made into chicken strips, PLU's most popular item served at The Commons) from Tyson Foods in Arkansas located more than 2,260 miles away. The chicken breast from Draper Valley purchased in the last budget year (last school year), emitted the carbon dioxide equivalent of greenhouse gas emission (eCO_2) of 447.6. This is equivalent to the average emissions for annual electricity use of 54.3 U.S. homes or the emissions emitted from using 1,040.89 barrels of oil; that's 43,717.38 gallons of oil. The Tyson breaded tenderloins on the other hand, had a eCO_2 of 1,372.37, which is equivalent to the same emissions from electricity use in 166.5 U.S. homes or 3,161.36 barrels of oil; that's 134,045.52 gallons of oil. To give you a better idea of just how much oil that is, it could fill a mid size car with a 15 gallon tank could be filled up nearly 9,000 times! Also, mind you that the emissions from the Tyson breaded tenderloins are approximately twice the amount of emissions from electricity (574 MTCDE or eCO_2, which is 4% of total PLU emissions as calculated by McKinstry and PLU (PLU "Emissions"). It is a fair assumption to say that if PLU calculates the emissions from all of its food it will be near or even surpass the PLU total emissions calculated in 2009.

For all of the figures found in the calculations please see the table in Appendix B on Page 30.

Because these seven food items were not an accurate representation of the food consumed at PLU, I compared a few of the food item emissions at the same amount in pounds. For all the chicken consumed at PLU, their pounds and mileage were compared to the same pounds and distance traveled with soybeans, a food staple often used as a meat replacement. The total chicken eCO_2 amounted to 2,297.69, which is the same as the average annual electricity use of 279 U.S.

homes and the consumption of 5,343 barrels of oil or 224,406 gallons of oil. The soybean comparison to chicken came out to only 1.56 eCO_2, which is the same as the average electricity use of 0.19 U.S. homes, 3.63 barrels of oil or 152.46 gallons of oil. I made the same comparison with the frozen beef patties and traditionally grown frozen spinach. The total pounds of frozen beef patties produced by Advanced Foods in Cincinnati, Ohio that was consumed at PLU last year amounted to 6,980 pounds of patties. Traveling 1,857 miles, the eCO_2 were approximately 2,450; this is the equivalent to the electricity use of 297 U.S. homes, or 5,700 barrels of oil, or a little more than 239,000 gallons of oil. The frozen spinach equivalent came out to be only 20.94 eCO_2. That's the same as the average annual electricity use of 2.5 U.S. homes or the consumption of 49 barrels of oil (2,058 gallons of oil).

Clearly, there is a big difference between locally produced meat and meat travel miles, emissions from produce versus meat. A big part of this difference is the amount of feed that animals are fed and that impact along with processing and travel miles. This also brings me to a point that author Tom Standage brings up in *An Edible History of Humanity*. Standage writes:

> Shipping all that food around causes carbon dioxide emissions that contribute to climate change. This has given rise to the concept of "food miles"- the notion that the distance food is transported gives a reasonable measure of its environmental damage caused and that one should therefore eat local food to minimize one's impact… It sounds plausible enough, but the reality is rather more complex. For one thing, local products can sometimes have a greater impact than those produced in other countries, simply because other countries are better suited than others to produce particular foods. (Standage 102)

Standage gives the example from Lincoln University's study to determine whether lamb produce in Britain versus lamb from New Zealand produced less carbon dioxide. The lamb from New Zealand produced 563 kilograms per metric ton of meat versus the 2,849 kilograms per metric ton as the lamb produced in Britain; largely because lamb in Britain is given feed, and the production methods is carbon intensive while the lambs from New Zealand has pasture to roam and are grass fed. Even though it takes 125 kilograms per metric ton of carbon to transport lamb from New Zealand to Britain, with these transportation impacts considered, they are still more energy efficient than the lamb produced in Britain (Standage 102).

This brings up another aspect of how foods require more water, pesticides and ultimately energy to produce and transport should be taken into account when selecting suppliers for food

items at PLU. The CHEFS program has a standard for transportation but it doesn't indicate what form of transport was used. Standage writes that

> A large ship can carry a ton of food 800 miles on a gallon of fuel; the figures are about 200 miles for trains, 60 miles for a truck, and20 miles for a car. So to drive to and from a shop or market can produce more emissions, for a given weight of food, than the whole of the rest of its journey."(Standage 102)

The method of transportation is just another factor to consider when talking with a supplier determines the sustainability of a food source.

Finding the emissions of our food consumption enables us to ask the questions to determine the real impact of our food we consume. Taking into account the emission equivalent of our food, the locality, seasonality and methods by which they are produced can create an avenue to make better strives to provide more sustainably grown and produced foods that will have less of a negative impact socially, environmentally and help PLU strive towards its carbon neural goal. The more we know about where our food comes from, how it is produced, and how it is transported to campus can be the beginning to making great strides at PLU's food emission footprint.

Survey Results

A survey was conducted of 73 sophomore, junior and senior PLU students during Fall 2012 to understand whether their PLU education has changed their eating habits to become healthier and more sustainable. I want to examine how students choose what they eat and whether their PLU education contributed to any changes in eating habits. In particular, I wanted to understand whether students had changed or reduced their meat consumption based on what they know about the main contributors to global climate change and the impacts of the food industry. I hypothesized that students who have completed an environmental studies class or have an interest in environmental issues would reduce their meat consumption or shifted to more sustainable eating habits.

A random selection of 300 students (100 sophomores, 100 juniors, 100 seniors) was invited to participate in the survey. I assumed upper classmen spent more time on campus and have established a better routine and eating habits on campus. I omitted first year students from my survey because at the point when the survey was administered, they would have only been on campus for half of a semester. The survey findings resulted in responses from 73 students, (26

sophomores, 24 juniors, 20 seniors). Of these respondents, 75.3 % or 55 participants responded as female and 20.5 % or 15 participants responded as male.

Respondents were asked to list the top human contributors to global climate change from 1 to 3 or answer "I am not sure" if they did not know the answer. Among the 27 students who complete an environmental studies course in high school or at PLU, the greatest percent (29.6%) incorrectly identified energy (use of fossil fuels, transportation and natural or anthropogenic avenues) as the highest human contributor to global climate change. The same percentage of these students answered, "I am not sure" to this question. The third highest response was carbon dioxide or greenhouse gas emissions at 22.2 %. The lowest category and the correct answer to the survey question, was agriculture and factory farming, at 7.4%. I was surprised at the low percentage of students who responded that agriculture and factory farming was the highest contributor of global climate change.

Among the 42 students who had answered that they had *not* taken a course in Environmental Studies, the largest percent (35.7 %) identified energy as the most important contributor, followed by "I am not sure" (31 %), and less specific answers such as ignorance, inactive, overpopulation and overconsumption. Only 4.8 % of these respondents, again the lowest percent answered agriculture and factory farming as highest human contributor of global climate change.

Based on this comparison, it appears that completion of an environmental studies course does and does not ensure an accurate response to the question of the cause of global climate change. After reassessing my question, I realized that the question did not specify if students had taken a course in Environmental Studies that talked about impacts of the food system on global climate change. Nevertheless, I think this statistic should be that 100 % of students at PLU should answer agriculture/factory farming when asked this question.

The response about the main contributors of global climate change of the participants did not change based on gender. When asked to list the top three contributors to global climate change, those that answered as agriculture and factory farming to be the top contributors were 35 to 39 % of both 55 females and the 15 male respondents said the biggest contributing factor was energy (fossil fuel, transportation…etc.). While nearly a third of both groups responded, "I am not sure." Overall, gender does not seem to be a significant factor in determining what students know about the main cause of global climate change.

Another indicator that students are aware of the implications of the food industry on the environment is their participation in Meat Free Mondays (MFM). When asked if students are currently participating in Meat Free Mondays or Meatless Mondays at PLU, the approximately 15 % of 26 sophomores and 20 seniors surveyed answered that they are practicing MFM every Monday. 23-25 % of the sophomores and seniors said they practice MFM when they remember or eat meatless at least one day a week. On the other hand, the biggest percentage of the three classes, approximately 42 % of the 24 juniors surveyed did not know about MFM or Meatless Mondays. These inconsistencies across the board demonstrate that waves of students are being educated about MFM and others are not, but that there has not been consistent education about MFM and about impacts of the meat industry and even more broadly, animal rights issues. There was no difference in the number of male or female students who answered this question. Gender is not a significant factor in whether students participate in MFM.

When looking at the students surveyed who had said they had taken a course in Environmental Studies and those who practice MFM, 28 of the 71 students surveyed had taken at least one environmental class in high school or in college. Of these students, 11 or 42.8% said they either practice MFM every Monday, when they remember, or eat meatless at least once a week. 9 of these 28 students or 32.1% said they do not practice MFM while 7 of the 28 students or 25% did not know about MFM. Of the 43 students how had not taken any a course in Environmental Studies, 23 or 25.6% said they practice MFM every Monday, when they remember or eat meatless at least once a week. 19 of these students or 44.2% of those who have not taken an Environmental Studies class said they do not practice MFM, while 13 of the 43 students or 30.2% did not know about MFM. In this regard there is a difference in students who have taken at least one class in Environmental Studies and those who have not when it comes to practicing MFM by 17.2%. However, I find the difference of those who do not practice MFM or know about MFM as very significant and these numbers show the lack of knowledge about MFM across the board in both groups.

Additional findings include that there was little relationship to class standing and the importance of convenience, cost and personal health as dietary. Each of these factors were rated highly across the board for each class, acknowledging that the majority of students care about their personal health while factoring in the cost and convenience of the food items they choose to eat. This means that by making healthier food more accessible and at a more reasonable cost for students, more students would then be able to choose the foods they want to eat because they can

find and afford them. To say the least, the food system that is in place does not always allow such amenities. PLU Dining has begun this year to provide fresh produce and cooking classes for students to help with this process, which I think will help them make better decisions in the future.

On a more hopeful note, 57% of the 73 students who responded to the survey said that since attending PLU, sustainability has become an important aspect of their life. The trend displayed higher percentages with the lower classman: 61.5% of the sophomores, 58% of the juniors and 57% of the seniors surveyed. Meaning that with each coming year, sustainability is becoming an ever vital component of students learning at PLU. The students in higher grades responded that since attending PLU, their eating habits have been more sustainable for the environment. Approximately 37% of the 20 seniors, approximately 30% of the 24 juniors and approximately 23% of the 26 sophomores agreed with this statement.

Looking at student's eating habits, older students indicated that their eating habits changed after learning about food justice: 25% of seniors, 16.7% of juniors, 11.5% of sophomores. Students in higher class standing also reported in more agreement that since their time at PLU, they influenced at least one other person's eating habit based on what they know about the impacts of the food industry: 45% seniors, 20.8% juniors, 11 % sophomores. There is progress being made, as students reaching their senior year are recognizing that they have changed their eating habits and made a positive impact on other students pertaining to food justice and conscious eating habits.

From this survey, we can learn that PLU is heading in the right direction and gradually making efforts to make sustainability an ever-present aspect of the PLU experience. However, there is still progress to be made at PLU to bring greater awareness to the greatest human contributor to global climate change through campus wide education pertaining to food and the environment. Greater awareness about food justice, the impact of food production on the environment and how to be a conscious consumer are great goals that can be achieved a PLU to transcend beyond their college experience.

Universities and other Dining Services in Action

After contacting the dining services and/or the sustainability office representative at 30 other universities in either PLU's athletic league, local vicinity, sister Lutheran universities, top

eight schools that earned the highest grade in the College Sustainability Report Card 2011 or a selected few practicing a form of Meat Free Mondays; fourteen universities responded. Of these fourteen schools, four have Bon Appétit as their dining provider, one has Sodexo as their dining provider, one has Aramark as their dining provider, seven of the universities are practicing a form of Meat Free or Meatless Mondays and one university has calculated green house gas emissions from their university's food consumption. Here is what they are doing to address the impacts of food emissions, reduce meat consumption and make the dining experience at their university more sustainable.

The University of Puget Sound, George Fox University, St. Olaf College and Pomona College are the four universities that replied to my message with Bon Appétit as their dining provider. These universities automatically participate in Bon Appétit's Low Carbon Program that began in 2007. Its goal is to reduce greenhouse gas emissions from the highest impact areas by 25 percent in the given business. The program is a three-year project that entails the following guidelines according to their website:

- Bringing the issue of the food system's impact on climate change to national prominence
- Sourcing nearly all of our fruits, vegetables, meats, and water from North America
- Providing science-based educational materials so our guests can make "lower carbon" food choices
- Reducing food waste and innovating creative options for used frying oil and compostable vegetable matter
- Auditing the energy and water efficiency of our kitchen equipment
- Hosting an annual Low Carbon Diet Day to create awareness and spur our guests to make change (BON APPETIT)

In 2008, Bon Appétit also came out with their Low Carbon Calculator that enables each individual customer to use this online tool as a way to calculate the carbon emission equivalent of their projected portions and meal.

Luther College has Sodexo has their dining provider. Serving 50 million meals a day in schools, hospitals and offices, Sodexo initiated their own sustainability program called "Better Tomorrow Plan," launched in the October of 2009 (Sodexo "Report"). As part of this program their managers utilize Sustainability Management and Reporting Tool (SMART), an online program to check their progress, evaluate their practices and determine their next steps to be more sustainable (Sodexo "Report"). Sodexo have outlined "14 Better Tomorrow Commitments." The three sections of their commitments include Nutrition, Health & Wellness;

Local Communities; and the Environment. Here are a few of their commitments under the Environment section as stated directly from their website:

- We will source local, seasonal or sustainably grown or raised products in all the countries where we operate.
- We will source sustainable fish and seafood in all the countries where we operate.
- We will reduce our carbon footprint in all the countries where we operate and at clients' sites.
- We will reduce our water footprint in all the countries where we operate and at clients' sites.
- We will reduce organic waste in all the countries where we operate and at clients' sites. We will support initiatives to recover organic waste.
- We will reduce non organic waste in all the countries where we operate and at clients' sites. We will support initiatives to recover non organic waste. (Sodexo "Commitments")

Also according to their website, 100 percent of the coffee provided by Sodexo is TransFair Fairtrade Certified, Sodexo chef's on college campuses in North America source fresh and seasonal produce from 700 local farms and they are helping increase sustainable efforts on farms by working with farmers on Good Agricultural Practices (GAPs) (Sodexo "Commitments").

Of the schools practicing a form of Meat Free Mondays or Meatless Mondays, a non-profit initiative by The Monday Campaigns to reduce individual's meat consumption by 15 percent for personal and environmental health (Meatless Mondays), I spoke with representatives from Western Washington University and Yale University about their experiences of implementing Meat Free Mondays along with other initiatives their campuses are implementing to deduce meat consumption. Seth Vidana, Western's Sustainability Coordinator, said initiating Meatless Mondays on their campus was met with few people opposing the idea but most people were neutral about the transition. When they went tray-less in their dining halls, they said they were "piloting" the program, and this word usage makes the initiative sound temporary; with time it can eventually become permanent. He also referred me to Thomas Koerner, the Director of Operations at Western, for more information about Meatless Mondays. Koerner's response included the following:

> Meatless Mondays was presented to the dining committee here at Western Washington University. The students overwhelmingly rejected the idea of going meatless on Mondays. Our programs offer vegetarian and vegan choices on one station at each dining hall seven days a week. We have a student sustainability intern that works with students to educate them on these issues.

Then I spoke with Ron DeSantis, CMC and Director of Culinary Excellence at Yale Dining. He has been in the food service for 30 years, is 1 of 66 master chefs in the U.S., and prior to his current

position at Yale, he was working at the Culinary Institute of America (CIA). He said there are no easy answers when our culture sees meat at the center of the meal. Though he still considers himself a freshman at Yale, because he had only been working there for six months at the time that I spoke with him, he was still very knowledgeable and eager to talk about what Yale Dining has been doing with regards to reducing meat and sourcing local foods.

Yale was approached by the organization Meatless Mondays, even Paul McCartney came to the university to promote the cause. Yale Dining wasn't sure how they were going to configure this campaign into their agenda successfully, so they figured they could still offer chicken breast with the meatless meal. The representatives from the organization said no way, it was all or nothing. DeSantis eventually called the president of Meatless Mondays, who said that it doesn't have to be all or nothing, as long as they label their vegetarian items. Yale hosted their first "Less Meat Monday," which they strategically renamed because they were still offering meat, on the day when prospective students came to the university to show them what Yale was all about. According to DeSantis it was a great success. Less Meat Mondays at Yale is solely a Dining effort, though they do not practice Less Meat Mondays every Monday for fear of battling with athletes who feel that they need to have their meat protein and large quantities. DeSantis is still trying to fit more Less Meat Mondays onto their calendar.

Even if Yale Dining serves 14,000 meals a day in 13 dining halls on their campus, they are still finding ways to increase the amount of local produce they provide and reduce the portions of meat they serve. They only buy high quality meat from Niman Ranch where they know the animals have been humanely treated and all of their chicken is from a small grower Murry's Chicken in upstate New York that's always fresh and never frozen, and most of their seafood is wild Alaskan salmon. Their student farm also helps provide a lot of their fresh produce. They try to provide the right choices for their students and make sure that it is "wholesome, nutritious, and much more plant-based than ever" as DeSantis said. By doing so they try to not highlight the meatless but highlight the quality food that they are providing. They are looking into new recipes too. A few of their new vegetarian options include Korean BBQ Tofu Tacos, Ginger Cherry Quinoa and they have found that sweet potatoes make a great base for making veggie burgers. Lastly, Yale Dining collaborates with the Yale Sustainable Food Project who compiles more of the research and provides education about the environmental impact of food. The Yale Sustainable Food Project

came out with a "Sustainable Food Purchasing Guide,"[23] outlining sustainable food purchasing practices while including the impact of meat products. The guide describes the best and worst sources of food for the wellbeing of the animals, environment and human health. Yale University is proof that no matter if a school is big or small, it can still find ways to reduce the overall protein intake and provide more local food that is sustainable, nutritious and tasty.

Samantha Meyer, Pomona College Dining Services' Sustainability and Purchasing Coordinator wrote that though they have not calculated carbon emissions based on meat consumption on their campus they "are aware that this has significant impact and we make an effort to reduce meat consumption." Their meat reduction programs include: Meatless Mondays, repositions meat to discourage consumption, offering just one meat option per meal, student outreach and education.

At the University of California Santa Cruz they are also practicing Meatless Mondays. Clint Jeffries, the Sustainability Manager for UCSC Dining, wrote that they have not calculated their carbon footprint based on food purchases but they have set meat reduction goals by 10 % by 2013 and as of February their Chancellor has signed a commitment to purchase more than 40% sustainable foods based on the criteria from the Real Food Challenge by 2020. The primary purpose of the Real Food Challenge is to make $1 billion dollars of existing budgets in universities to go towards locally sources, fair, humane and environmentally sound sources of "real food" instead of industrial produced and processed foods by 2020. Such aspects of the program also include a Real Food Calculator. As for Meatless Mondays Jeffries writes:

> Meatless Mondays are a permanent part of our menu cycle. We have 5 dining halls. Each week, one of our dining halls has Meatless Monday, serving no meat at all. We do advertise for Meatless Monday. Students both choose that dining hall, and avoid it on purpose for Meatless Monday. We have found that the menu is crucial. When the menu is good, our numbers stay the same as regular service days.

Aramark, the food provider at UC Santa Cruz, helped develop a way to calculate food emissions for other food services with Clean Air- Cool Planet, the same non-profit group that works with PLU to find and promote solutions to global warming, have created Charting Emissions from Food Services (CHEFS). The program quantifies "the environmental impact of growing, producing, transporting, preparing and disposing of food on North American college campuses" (ARAMARK).

---

[23] The full "Sustainable Food Purchasing Guide" by Yale University can be found at http://www.yale.edu/sustainablefood/purchasing_guide_002.pdf.pdf.

CHEFS is the tool that I was able to calculate the food emissions for this project, which I found more helpful than finding my own means or equation of doing so.[24]

Sustainability Manager of Dining at University of California Davis, Danielle Lee, shared with me their pages about their "Meatless Monday Promotions and Activities" as well as their "Sustainable Foodservice Progress Report" from 2011. Their Meatless Monday page outlines the history of Meatless Mondays, the activities they put on to promote Meatless Mondays and how they reward students who pledge with a button and those who are particularly engaged in the campaign are recognized each quarter on posters in the dining room. The Meatless Monday concept began in World War I and showed up again in 2003 thanks to the John Hopkins Bloomberg School of Public Health's Center initiative to reduce saturated fat intake by 15 percent in schools, which later added the environmental benefits of meat reductions to their campaign (UC Davis "Meatless" 1). The "Sustainable Foodservice Progress Report" is a highly thorough report outlining all of the sustainable aspects of UC Davis's from how they have reduced their waste output, the methods by which they are educating students about the nutritional and environmental benefits of food and more crucial to this investigation their sustainable food purchases. Just looking at their resident dining here are the percentages of their sustainable food purchase, which amount to 21.35 percent of their total food purchases:

- 24% of meat and seafood purchases are sustainable
- 90% of all eggs are cage-free, humane
- 48% of dairy purchases are local, humane dairy
- 100% coffee is certified Fair Trade
- 45% of produce is local (within 250 miles) (UC Davis "Report" 2)

UC Davis is doing a lot to be ever-increasingly sustainable within their Dining Services. It is good to note that the campus also has their own farm and some livestock that they raise and slaughter on campus as well.

The Marketing Assistant at the University of Virginia's Dining Services, Amber Wilson, responded to my message. She wrote, "We have not personally calculated emissions from consuming meat, but we have had a lab specialist in the Department of Environmental Sciences partner with us to calculate the difference in emissions between our Meat Free Monday dishes and a traditional dish on our menu." They are also practicing Meat Free Mondays and it is a concept they

[24] One is able to set up their own account and start calculating emissions at http://www.cleanair-coolplanet.org/chefs/.

plan on continuing indefinitely. So far their biggest challenge has been implanting a menu with a variety of Meatless Monday dishes that are both innovative and delicious. Their second challenge has been the response from students. Wilson wrote:

> There were students who wanted us to commit to being completely meat-free on Mondays, but that was not how we structured our program. We believe that eating meat-free should be a choice, and we did not want to remove that option from students who wanted to eat meat on Mondays. As a result, we have seen a greater number of students opting for the Meat Free Monday dish. We also had students comment on how informative the nitrogen emissions posters were.

The consensus is that the majority of the universities that replied to my messages agree that the impact of the meat industry is bad and many are finding means to reduce meat on their menus. Overall they are focusing on purchasing local produce, and to continue to provide nutritiously good food at their universities. Some are striving to make the reduction of meat and its impacts a priority alongside other sustainability initiatives whether it is student driven or run by their dining services.

What now?

With all the information now in hand, what steps can PLU take to be even more sustainable? Here is a list of my recommendations that the campus and Dining & Culinary Services can make in order to recognize and address food emissions as a part of PLU's ecological footprint:

1.) **Compile a Sustainability Report of PLU Dining & Culinary Services**: By understanding the full impact of food sources, food consumption, food waste, water use, electricity use and so on, it enables the Department of Dining & Culinary Services to address these areas to reduce its energy use. To compile the report, Charting Emissions from Food Services (CHEFS) online program from Clean Air – Cool Planet can help compile food emissions. The Real Food Calculator from the Real Food Challenge can see what percentage of PLU food is "real," to identify what areas of food at PLU can eventually be replaced with organic, locally grown, sustainably and humanely grown food. If this report is compiled every few years, PLU can then witness Dining's sustainability progression.

2.) **Set strict goals for 2020**: Once the dining sustainability report is compiled then Dining & Culinary Services goals can be set. Goals such as meat reduction, what percentage of food should eventually be from sustainable and humane sources, and what timeframe would work best to accomplish these goals can be put in place. The Commons Operations Manager at PLU, Wendy Robins, who has been a crucial asset for this investigation, suggested that Dining set a goal to

replace unsustainable foods by 10 percent each year until 2020 with sustainably foods. With a goal like this one, PLU Dining would be well on its way to providing more local, organic, healthier and more humanely produced food to an ever-shrinking carbon footprint. These goals can then be addressed as part of the President's Climate Commitment, as a way for the university to acknowledge the impact of food consumed on campus as part of PLU's ecological footprint.

3.) **Revive and Rebrand Meat Free Mondays**: Depending on what you want to call it, Meat Free Monday, Meatless Monday or Less Meat Monday, the initiative at PLU needs a little boost. To make Meat Free Mondays a big deal it needs to be approached as such. This means more advertisement every Monday at the various food stations providing vegetarian options. (See the *Green Guide to Dining Posters* developed by the author beginning on page 33 of Appendix C.) And why not try what Pomona College has been doing and provide just one sustainable meat option at each meal on Mondays and replace other meat dishes with more popular meatless alternatives? If the meat choices are reduced on Mondays and switched out for delicious vegetarian alternatives, dining customers will not see the initiative as taking away their meat but educating them about the various tasty and healthy meatless options that are out there. Therefore, Meat Free Mondays will be a more successful campaign. Doug Hinners said Meat Free Mondays should be something that "tempts and entices" customers to try the meatless options. He also said, some "rebranding" needs to take place so that "the customers are making the choice to help the environment and not giving something up to help the environment." This isn't to say Meat Free Mondays should not be solely an effort from Dining; it will take a great deal of effort from students, staff, and faculty who support the campaign to do their part. Incentives and recognizing students, as UC Davis has done, for being involved with the campaign is another option as well. The beginning of the school year, The Commons on Fire, Culinary Week and Earth Week are great times to keep educating Dining customers about the health benefits and environmental impacts of reducing their meat intake by choosing more nutritious and sustainable options. These times of the year do not need to be the only days dedicated to educating dining customers. Each Monday can be designated for educating and sharing the health and environmental benefits of choosing to eat delicious and sustainably produced meatless options with advertisement and facts posted in The Commons every Monday. Free posters are available to be downloaded from the Meatless Monday website and the Green Guide to Dining, as a supplement to this project can also be a reference or educational tools.

4.) **Employ a Student Sustainability Intern(s)**: With all of these recommendations and hopefully plans for sustainability in store, why not employ a student (or a few) to help with compiling the sustainability report, finding calculations, and working with other clubs and organizations on campus to educate students about the health and environmental benefits of choosing sustainably grown food? This position could also be in conjunction with the Sustainability Department to keep those ties and sustain the relations between the two departments. Depending on how much money is in the Dining and Sustainability budget, this position could also just be in place the years that the sustainability reports are being compiled. Though this is a decision that would need to be made by Director of Culinary & Dining Services, Erin McGinnis, Wendy Robins and probably Chrissy Cooley in Sustainability as well, with such a role on campus we can ensure that progress will be made towards more sustainable food choices and practices at PLU.

5.) **Offset Food Emissions**: For all of the food emissions that cannot be reduced through finding more sustainable sources, I then suggest that the university buys offsets to counter these emissions. Dining already gets one offset credit for selling used cooking oil to be reused as biofuel. Other strategies such as this one and buying offsets can make PLU Dining carbon neutral as well. As PLU reduces food emissions over time, less offsets will need to be purchased to attain the carbon neutral goal by 2020.

Conclusion

The drought this summer affected much of the corn and soy crops in the Midwest. Some project that we will see price hikes on meat, dairy products and possibly even processed foods containing high fructose corn syrup due to the suffering crops. With this in mind, all of the information provided in this report, and its recommendations, I strongly advise that Pacific Lutheran University and its Dining & Culinary Services Department make haste in incorporating the impacts of campus food emissions into the university's overall campus emissions and goal for carbon neutrality by 2020. By learning and sharing information on campus about the true impacts of our food industry, (especially the meat industry), revitalizing campaigns such as Meatless Mondays and understanding the true impact of campus food emissions, PLU will be well on its way to setting and accomplishing goals that are crucial to making this university one hundred percent carbon neutral by 2020 as it leads the way for other universities to follow.

Appendix A: Gas Emission Break Down

The 2007 US Greenhouse Gas Inventory for Agricultural Emissions identifies the normal digestive process, enteric fermentation, as responsible for more than half of the methane emissions followed by manure management (PEW 27). Cows are ruminants, with four different stomachs to digest their cellulose heavy diet. They emit methane each time they regurgitate their food, then breaking it down further when it travels to the next stomach. *Enteric fermentation* is a natural process but is heightened when cows are fed strictly corn, soybeans or alfalfa instead of their preferred grass. Dairy cows produce twice as much methane than cows raised for meat because they are lactating. Dairy cows that produce 8-10,000 liters of milk in a year produce 5,000 to 7,000 liters of methane a day, while an average cow may only produce 700 liters of methane a day, which is equivalent to the carbon emissions of a four by four vehicle traveling 35 miles a day (Thieme). According to the Environmental Protection Agency (EPA), ethane emissions from enteric fermentation are the second largest anthropogenic source produced in the United States, with natural gas systems being the largest source and landfills being the third (EPA Summary 9). When methane is emitted into the atmosphere, it persists 9 to 15 years, not to mention that atmospheric concentrations of methane have increased by 150 percent since pre-industrial times, even if they have recently been on a slight decline (Steinfeld 82). The United Nations estimates that global emissions of methane due to enteric fermentation come to 86 million metric tons annually, which is as much as Sweden and Norway's total annual emissions combined (Imhoff 242).

When is comes to emissions of nitrous oxide, the 2007 US Greenhouse Gas Inventory for Agricultural Emissions stated that more than 97 percent of the nitrous oxide emitted through agricultural processes comes from agricultural soil management, (such as fertilizing the soil to replenish nutrients,) and nearly three percent is released due to manure in waste management, (such as in the methane produced from all the manure from animal feedlots) (PEW 27). "In the United States," writes Lappé, "agriculture contributes roughly three quarters of all nitrous oxide emissions"(62). About 310 times more effective at trapping heat in the atmosphere than carbon dioxide, nitrous oxide can stay in the atmosphere for up to 114 years (Steinfeld 82; EPA Summary 3). The application of fertilizer and other practices contribute to making agricultural soil management activities the largest source of nitrous oxide in 2010, amounting to 67.9 percent of total nitrous emissions in the U.S. (EPA Summary 12-13). It is estimated that 40 to 60 percent of

nitrogen applied to crops as fertilizer, pesticides and herbicides actually end up in the soil or is lost through leaching; leading to the potential of excess amounts of nitrogen from fertilizer in underground water systems (Steinfeld72)[25].

Lastly, ammonia emissions from livestock operations amounts to 75 percent of reported ammonia emissions in the United States, while dairy cows raised in *concentrated animal feeding operations* (CAFOs) are more likely to emit 5 to 10 more times the ammonia as those that are pasture-raised (Imhoff 74)[26]. Not only that, but ammonia produced by livestock has show to significantly contribute to the eutrophication and acidification of soil and water sources. *Eutrophication* occurs when there is an excess of nutrients, such as nitrates and phosphates, in a body of water causing dense plant growth and lack of oxygen for many animal species living in those waters (PEW 25). Ammonia and nitrous oxide emissions accelerate the process of eutrophication that can occur naturally.

It may seem that livestock respiration through enteric fermentation releases a lot of the green house gases, yet it's only a small part of the overall emissions from livestock production. The 2006 FAO report briefly outline other methods contributing to the net carbon release:

- Burning fossil fuels to produce mineral fertilizers used in feed production;
- Methane release from the breakdown of fertilizers and from animal manure;
- Land use changes for feed production and for grazing;
- Land degradation;
- Fossil fuel use during feed and animal production; and
- Fossil fuel use in production and transport of processed and refrigerated animal products. (85-86)

[25] For the original information see: Matson, P.A., Parton, W.J., Power, A.G. & Swift M.J. "Agricultural intensification and ecosystem properties." 277 (5325) *Science*, 1997: 504-509.

[26] For more information please see: Doug Gurian-Sherman and C.W. Williams, "Doug Gurian-Sherman, CAFOs Uncoverd: The Untold Costs of Confined Animal Feeding Operations. Cambridge: Union of Concerned Scientists, April 2008: 54; C.B. Roller, A Kosterev, and F. K. Tittel, "Low Cost, High Performance, Spectroscopic Ammonia Sensor for Livestock Emissions Monitoring," *USDA Research, Education, and Economics Information System.*

Appendix B: Food Calculations and Emissions from last Dining Budget Year

Food Item	Total lb	Source	Miles to PLU	eCO2[27]	US homes[28]	Barrels[29]	Gallons[30]
CHICKEN							
Breast	18,679.68	Draper Valley Farms (Mt. Vernon, WA)	103.65	447.58	54.32	1,040.89	43,717.38
Breaded tenderloin	3,220	Tyson Foods (Arkansas)	2,261.27	1,372.37	166.55	3,161.36	134,045.52
Wings	1,220	Tyson Foods (Arkansas)	2,261.27	477.74	57.98	1,111.02	46,662.84
BEEF							
Frozen Patties	6,980	Advance Foods (Cincinnati, OH)	1,857.00	2,449.62	297.28	5,696.78	239,264.76
EGGS							
Liquid	15,810	Wilcox Farms (Roy, WA)	13.00	31.18	3.78	72.51	3,045.42
TOFU							
(lbs of soy beans to make same amount of tofu)[6][31]	445.05	House Foods (Garden Grove, CA) and Vashon Island, WA	1131.00 and 51.00	0.03	0.00	0.07	2.94
SPINACH							
Cello (fresh and frozen)	1,912	Salinas, CA	890.00	307.1	37.28	714.31	30,001.02

[27] *eCO2* stands for metric tonnes of Greenhouse Gas Emissions (eCO2) according to the Charting Emissions from Food Services (CHEFS) online calculator
[28] *US Homes* refers to the number of US homes it takes to match the eCO2 equivalent to the average home energy use.
[29] *Barrels* refer to the number of oil barrels equivalent to the same amount of eCO2.
[30] *Gallons* refer to the number of gallons of oil equivalent to the same amount of eCO2. There are 42 gallons in one barrel of oil.
[31] Based on the *Tofu's Carbon Footprint* by Tiffany Plate.

Appendix C: Green Guide to Dining Posters

Green Guide to Dining

Tips to reduce your meat consumption
for a healthier planet and a healthier you

Take the pledge and participate in the Meatless Mondays Campaign. By choosing to not eat meat one day a week you could be saving as much greenhouse gases as if you switched driving a regular four by four car to an energy efficient Toyota Prius. This also gives you the opportunity to discover and try the variety of healthy and delicious meat-free options.

Did you know?

Livestock activities attribute to an estimated 18 % of total global anthropogenic (human-made) greenhouse gas emissions from the following sectors: energy, industry, waste, land use, land use change, forestry and agriculture. (UN FAO, *Livestock's Long Shadow*, 2006)

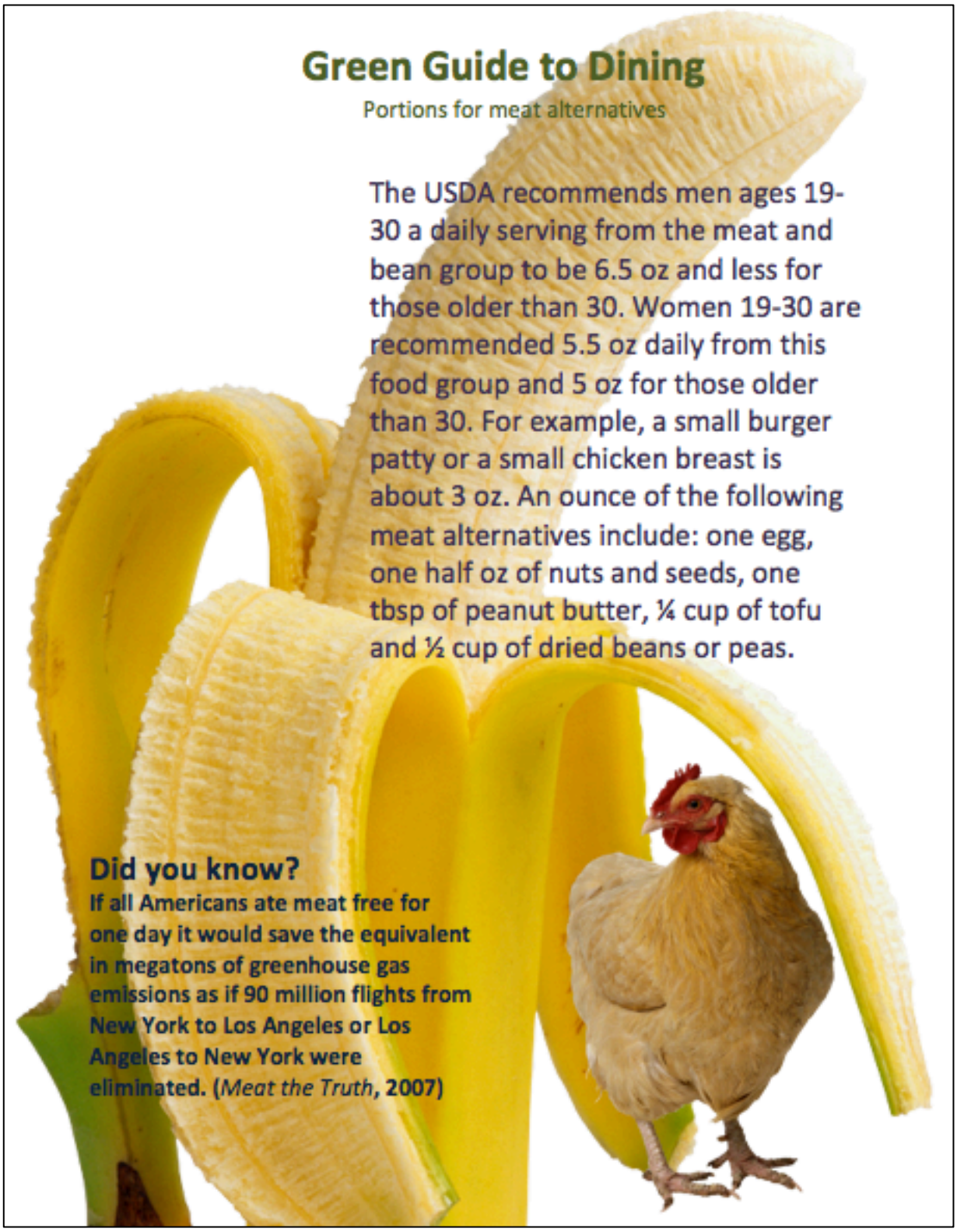
Green Guide to Dining

Finding nutritious and tasty meat alternatives

Most people are concerned to limit their meat consumption, becoming vegetarian or vegan for environmental, ethical, health or religious reasons because they don't know where to get their protein and other vital nutrients for a healthy diet. Vegans must be especially careful and eat enough of the following: whole grains; legumes; nuts and seeds; vegetables; fresh fruits and juices low in refined sugars. Complete protein replacements for meat include some of the following combinations:

- Peanut butter sandwiches on whole wheat bread
- Split pea soup on a whole wheat roll
- Brown rice and chick peas
- Rice and tofu
- Corn tortillas with red kidney beans
- Lentil patty on a whole wheat bun
- Pasta and cheese

Other vegetarian super foods include: almonds, dried apricots, eggs, quinoa, lentils, cheese, milk, yogurt, rolled oats, sesame seeds, soybeans and soy products, spinach and sunflower seeds.


Green Guide to Dining
Portions for meat alternatives
The USDA recommends men ages 19-30 a daily serving from the meat and bean group to be 6.5 oz and less for those older than 30. Women 19-30 are recommended 5.5 oz daily from this food group and 5 oz for those older than 30. For example, a small burger patty or a small chicken breast is about 3 oz. An ounce of the following meat alternatives include: one egg, one half oz of nuts and seeds, one tbsp of peanut butter, ¼ cup of tofu and ½ cup of dried beans or peas.
Did you know?
If all Americans ate meat free for one day it would save the equivalent in megatons of greenhouse gas emissions as if 90 million flights from New York to Los Angeles or Los Angeles to New York were eliminated. (Meat the Truth, 2007)

Work Cited

American College & University President's Climate Commitment. "Mission and History." ACUPCC. 2007-2012. Web. Accessed 20 Jul. 2012. http://www.presidentsclimatecommitment.org/about/mission-history

American College & University President's Climate Commitment. "Text of the American College & University Presidents' Climate Commitment." 2007- 2012. Web. http://www.presidentsclimatecommitment.org/about/commitment

ARAMARK. "ARAMARK supports Development of New Clean Air-Cool Planet Food Service Carbon Tracking Tool." 21 Sept. 2009. Web. http://www.aramark.com/PressRoom/PressReleases/Clean-Air-Cool-Planet.aspx

Bittman, Mark. "Rethinking the Meat Guzzler." *New York Times*. 27 Jan. 2008. Web. http://www.nytimes.com/2008/01/27/weekinreview/27bittman.html

BON APPETIT MANAGEMENT COMPANY. "Low Carbon Diet." Accessed 17 Jul.2012. Web. http://www.bamco.com/sustainable-food-service/low-carbon-diet

Brown, Lester R. *Plan B 4.0: Mobilizing to Save Civilization*. New York: Earth Policy Institute, 2009. Print.

CNN U.S. "Oprah accused of whipping up antibeef lynch mob." CNN. 21 Jan. 1998. Web. http://articles.cnn.com/1998-01-21/us/9801_21_oprah.beef_1_cattle-prices-mad-cow-disease-howard-lyman?_s=PM:US Accesed:12 Jul. 2012.

Darragh, Brigid. " In Vitro Meat: The Case for Beaker Bacon." *Green Chip Stocks*. 4 Feb. 2011. Web. http://www.greenchipstocks.com/articles/in-vitro-meat-the-case-for-beaker-bacon/1238

DeSantic, Ron. "Personal Interview." 6 Jul. 2012.

Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010* (Executive Summary). April 2012. Web.

Foer, Jonathan. *Eating Animals*. New York: Back Bay Books/ Little, Brown and Company, 2009. Print.

Fussell, Betty. *Raising Steaks: The Life and Times of American Beef.* Orlando: Houghton Mifflin Harcourt Publishing Company, 2008. Print.

Gregg, Matt, Christine Cooley and David Kohler. "Climate Action Plan & Sustainability Guide." 14 Jan. 2010. Web.

Hinners, Doug. "Personal Interview." 30 July. 2012.

Imhoff, Daniel. *The CAFO Reader: The Tragedy of Industrial Animal Factories*.
Healdsburg: Foundation of Deep Ecology with Watershed Media, 2010. Print.

Jeffries, Clinton. "Meat Free Mondays." Message to the author. 18 Jul. 2012. E-mail.

Ketzenberger, Jolene. "Meatless meals gain in popularity for budget, health reasons." *USA Today*.10 Mar. 2012. Web. http://www.usatoday.com/news/health/wellness/fitness-food/story/2012-03-10/Meatless-meals-gain-in-popularity-for-budget-health-reasons/53445804/1

Koerner, Thomas. "Meatless Mondays." Message to the author. 28 Jun. 2012. E-mail.

Kromm E. David. "Ogallala Aquifer." *Water Encyclopedia Science and Issues*. 2011. Web. http://www.waterencyclopedia.com/Oc-Po/Ogallala-Aquifer.html

Lappé, Anna. *Diet for a Hot Planet: The Climate Crisis at the End of Your Fork and What You Can Do About It.* New York: Bloomsbury USA, 2010. Print.

Markham, Derek. "Global Warming Effects and Causes: A Top 10 List." *Planet Save.* Web. http://planetsave.com/2009/06/07/global-warming-effects-and-causes-a-top-10-list/

Meatless Mondays. "About." The Monday Campaigns, Inc. 2003-2011. Web. Accessed 23 July, 2012. http://www.meatlessmonday.com/about/

Meyer, Samantha. "Sustainable Dining." Message to the author. 15 Jun. 2012. E-mail.

Motavalli, Jim. *The Case Against Meat: Evidence Shows that our Meat-Based Diet is Bad for the Environment, Aggravates Global Hunger, Brutalizes Animals, and Compromises Our Health*. 31 Dec. 2001. Web. http://www.emagazine.com/archive/142

Pacific Lutheran University Department of Dining & Culinary Service. "Sustainability @ PLU Dining & Culinary Service." n.d. Accessed 20 Jul. 2012. http://www.plu.edu/diningandculinary/Sustainability/home.php

Pacific Lutheran University Sustainability Office. "Current PLU Carbon Emission." Sustainability. n.d. Web. http://www.plu.edu/sustainability/About%20Us/home.php

PEW. *Putting Meat on the Table: Industrial Farm Animal Production in America.* A report of the PEW Commission on Industrial Farm Animal Production. n.d. Web. www.livablefutureblog.com/pdf/Putting_Meat_on_Table_FULL.pdf

Plate, Tiffany. *Tofu's Carbon Footprint*. http://tofuscarbonfootprint.weebly.com/carbon-calculations.html.

Pollan, Michael. *The Omnivore's Dilemma: A Natural History of Four Meals*. New York: The Penguin Group 2006. Print.

Robins, Wendy. "Personal Interview." 12 July, 2012.

Schlosser, Eric. *Fast Food Nation: The Dark Side of the All-American Meal*. New York: Houghton Mifflin Publishing Company, 2001. Print.

Shahan, Zachary. "NASA Says: Automobiles Largest Net Climate Change Culprit." *Clean Technica*. 23 Feb. 2010. Web. http://cleantechnica.com/2010/02/23/nasa-says-automobiles-largest-climate-change-culprit/

Singer, Peter. *Animal Liberation.* New York: The New York Review of Books, 1990. Print.

Standage, Tom. *An Edible History of Humanity*. New York: Walker & Company, 2009. Print.

Steinfeld, Henning et. al., *Livestock's Long Shadow*. Rome: Food and Agricultural Organization of the United Nations, 2006. Print.

Sudexo. "14 Better Tomorrow Commitments." Web. Accessed 18 Jul. 2012. http://www.tomorrowstarts2day.com/commitments.html

Sudexo. "2010 Sustainability Report: North America." 2011. Web. Accessed 18 Jul. 2012. http://bettertomorrow.sodexousa.com/home/

Thieme, Marianne. *Meat the Truth*. Nicolaas G. Pierson Foundation. Amsterdam, 2007. DVD. UC Davis Dining Services Sustainability and Nutrition Department. "Promoting Meatless Mondays at UC Davis." n.d. (Provided by Danielle Lee.) UC Davis Dining Services Department of Sustainability and Nutrition, Linda Adams RD, Danielle Lee, Sara Kosoff. "Sustainability Foodservice Progress Report 2011."Print. Accessed 19 Jul. 2012. http://dining.ucdavis.edu/documents/UCDavisSustainableFoodserviceProgressReport-2011_000.pdf

Vidana, Seth. "Personal Interview." 28 Jun. 2012.

Wilson, Amber. "Sustainable Dining." Message to the author. 20 Jun. 2012. E-mail.