6.S898 Final Project Report
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Edible Carbon: A website dedicated to the carbon footprint of eating

www.ediblecarbon.net

Introduction:

Human carbon emissions play a large role in altering the climate that we live in. As such, if we are to tackle the issue of climate change, then we must first address the current rate at which we emit carbon. Curbing global carbon emissions is a pressing priority if we are to mitigate climate change. This is a goal that is achievable only if individuals, legislators, political institutions, climate scientists, and countries work hand in hand. Currently, the attitude towards reducing carbon emissions is a blame game. Countries blame each other, and individuals criticize politicians and companies in the traditional energy sector. Ordinary people are not doing enough to help tackle global warming. I strongly believe that individuals choosing to live more carbon conscious lifestyles can greatly assist in reducing carbon emissions. There are a variety of things we can do as individuals to reduce our personal carbon footprint such as travel less frequently or use less electricity, but some of those things are not in our control. However, there are simple things that we all can do to positively impact the fight against climate change. What we choose to eat can drastically change not only our greenhouse gas emissions, but also help curtail short-lived climate pollutant production and improve air quality. A simple decision between choosing chicken instead of beef at Chipotle, or participating in the popular Meatless Monday trend has tangible carbon benefits. As a species, we are becoming increasing health conscious when it comes to our personal diets. Why are we not more aware of how our diet affects Mother Earth?

Problem:

There is a lack of general awareness around sustainable eating and the degree to which diet can affect an individual's carbon footprint. As a result, individuals do not feel empowered and motivated because they might think that their own actions are too small to make a substantial impact. This leads to less awareness for climate change and a negative feedback loop of caring about the problem less.

Additionally, while there are many resources that go into great detail about carbon emissions and the environmental impact of the animal agriculture industry, these resources are generally targeted towards people that already somewhat understand the carbon impact of their actions. Many of these resources are dense reports that are filled with text. It is unlikely that an ordinary individual will take the time to comb through these reports. To address climate change on a widespread basis, we need to widen the scope of awareness and educate all individuals on what they can do to reduce their emissions.

Approach:

In order to educate more people about the environmental and carbon emission benefits of eating sustainably, I created a website that helps educate individuals about the carbon emissions of their diet. My goal is to aggregate research from online resources, report findings, books, and documentaries and present this reseach in a digestible, more accessible, yet still impactful manner so that viewers understand that their dietary choices can positively impact the planet. Hopefully, after viewing my website, an individual will choose to be more carbon conscious when they choose their next meal. It is unreasonable to expect everyone to consume a vegan diet to reduce carbon emissions. However, climate change needs to be thought about on the margin.

If a subset of individuals makes the marginal decision to eat a chicken dish at a steakhouse, this can affect the supply chain dynamics of beef by reducing consumer demand. This decrease in consumer demand can then trigger a lowering of supply, thus reducing the number of beef cattle farms around the world and decreasing global carbon emissions.

Steps:

1. Using online resources, books, and documentaries, researched and compiled facts on greenhouse gas emissions, water use, and land use of beef, pork, poultry, dairy, and vegetables.
2. Calculated the carbon footprint of six common American meals (cheeseburger, chicken caesar salad, bowl of cereal, chips and guacamole, over-easy egg, and pepperoni pizza) by identifying carbon emissions of each individual ingredient used to make the meal and summing them to reach an aggregate carbon footprint for each meal.
3. Designed an easily accessible website that presents my research and calculations in a low-clutter, yet impactful manner.
4. Implemented website from scratch using HTML, CSS, and JavaScript.
5. Shared website with friends on social media to spread awareness.

In the following sections, I will detail how I conducted each step and also present relevant research findings.

Step 1: Researched environmental impact of animal proteins and a plant-based diet

The goal of this research was to compare and contrast the greenhouse gas emissions, land use and water use of beef, poultry, pork, dairy, and a plant-based diet. While a lot of attention is

rightfully paid to greenhouse gas emissions, it is important to consider land use and water use as well. With the advent of technological innovations such as carbon sequestration devices and renewable energy plants, how we efficiently allocate land will become critical. Additionally, much of the land used for agriculture is created by destroying forests and other carbon negative locations. Preserving forests and other carbon sinks is also an important goal in the fight against climate change.

Livestock and their byproducts account for at least 32 billion tons of carbon dioxide per year, or 51% of all worldwide greenhouse gas emissions.[1] Additionally, animal agriculture is responsible for 18% of greenhouse gas emissions[2]. The sheer magnitude of greenhouse gas emissions attributable to animals is enormous, and when we take a closer look at the specific animals that contribute to this footprint, it is undeniable that a change in diet can largely impact human-related emissions. Generally, the most substantial portion of an animal's carbon footprint is not actually produced by the animals themselves, but by production of the feed that the animals are fed. As such, an animal's carbon footprint is not only the emissions produced by the animals themselves, but also inclusive of their feed production. When thinking about specific animals, it is important to consider how efficiently an animal is able to convert feed into protein. Animals with lower feed conversion ratios place a greater strain on the environment.

Beef cattle are far and away the largest contributor to animal agriculture's greenhouse gas emissions. Beef production contributes 2.9 gigatons of carbon dioxide equivalent, close to 40%

[1] "The Sustainability Secret." COWSPIRACY. Accessed December 11, 2019. https://www.cowspiracy.com/facts?fbclid=IwAR1hF5Du9KPXMbBOJQmI_mcs3Vf0anos2ORlx5i_zL-5YPo5zpuataMtLGY.
[2] Steinfeld, Henning. Livestocks Long Shadow: Environmental Issues and Options. Rome: FAO, 2006.

of the livestock sector's total emissions[3]. Per a group of Columbia University graduate students' calculations, beef production alone contributes around 4% of total U.S. greenhouse gas emissions[4]. Beef cattle's high carbon emission rate can be attributed to two main causes: feed production and manure.

When it comes to feed conversion, beef cattle are the least efficient due to their dependence on processed roughage in addition to industrialized feed. Chickens (Poultry) consume 2 kilograms of grain to produce 1 kilogram of meat while pigs need 4 kilograms. In comparison, beef cattle need 10 kilograms of feed per kilogram of meat. This inefficient feed conversion ratio means that beef cattle strain the environment due to the constant expansion of agricultural land into natural habitats. More feed results in more nitrogen fertilizers, which react with water and produce nitrous oxide. According to the U.S. EPA, nitrous oxide is a highly potent greenhouse gas with 300 times more warming potential per pound than carbon dioxide[5].

Furthermore, enteric fermentation, the process by which beef cattle break down plant fibers into a digestible form produces the second most greenhouse gases for the livestock sector[6]. During this digestion process, grass ferments in the cow's stomach and interacts with microbes, producing methane. Due to their polygastric digestive system, cattle account for 77% of all enteric emissions[7]. Finally, the storage and processing of cattle manure releases nitrous oxide (N_2O) and methane (CH_4) into the atmosphere. Comparatively, because both poultry and pork

[3] Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. 2013. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.
[4] "HOLD THE BEEF." Atavist, June 8, 2017. https://holdthebeef.atavist.com/.
[5] Ibid.
[6] Ibid.
[7] Ibid.

are monogastric animals, they produce significantly less methane and methane related greenhouse gases. It is also prudent to distinguish dairy cattle from beef cattle. Though dairy cattle have rumens, their diet is skewed more towards concentrated feed. As a result, dairy cows have a greenhouse gas emission profile more similar to that of chicken and pork.

We now proceed to consider land use and water use. Livestock covers 45% of the earth's total land[8], and animal agriculture is responsible for 20-30% of all fresh water consumption in the world today[9]. The primary driver of land use and water use is also animal feed consumption. Beef cattle's inefficient feed conversion leads to it require 28 times the land and 11 times the irrigation water when compared to protein calories sourced from dairy, poultry, and pork.

It is evident that the environmental pressures resulting from animal agriculture are a function of the animal's ability to convert feed into animal protein. If humans were to instead consume a diet consisting of more plant-based proteins or animals such as chicken and pork that are more efficient in converting feed, we would be able to satisfy our protein needs without having to go through less efficient and more environmentally taxing animals. From an environmental standpoint, a vegan diet or diet primarily consisting of plant-based proteins is much more sustainable and significantly reduces greenhouse gas emission. To illustrate the discrepancy in the emissions profile of a meat eater and a vegan, consider this: A person who follows a vegan diet produces the equivalent of 50% less carbon dioxide, 1/13th water, and 1/18th land compared

[8] Thornton, Philip, Mario Herrero, and Polly Ericksen. "Livestock and Climate Change." Livestock and Climate Change, n.d.
[9] Gerbens-Leenes, P.w., M.m. Mekonnen, and A.y. Hoekstra. "The Water Footprint of Poultry, Pork and Beef: A Comparative Study in Different Countries and Production Systems." Water Resources and Industry 1-2 (2013): 25–36. https://doi.org/10.1016/j.wri.2013.03.001.

to a meat-eater.[10] Further, a person who eats a vegan diet saves 1100 gallons of water, 45 pounds of grain, and 20 pounds of CO_2 equivalent compared to their meat-eating counterparts[11].

The *Hold the Beef* team uses an apt chart to compare and contrast the environmental impact of different animals, dairy and vegetables. By normalizing every type of protein to a 1000 dietary calorie basis, they are able to fairly and successfully demonstrate the degree to which beef cattle is worse for the environment. From this infographic, it is clear that beef cattle emit significantly more greenhouse gasses. Based on this research, it is obvious that what you choose to eat largely determines your individual carbon footprint. Thus, individuals can positively impact global carbon emissions, land use, and water use through carbon conscious diet choices.

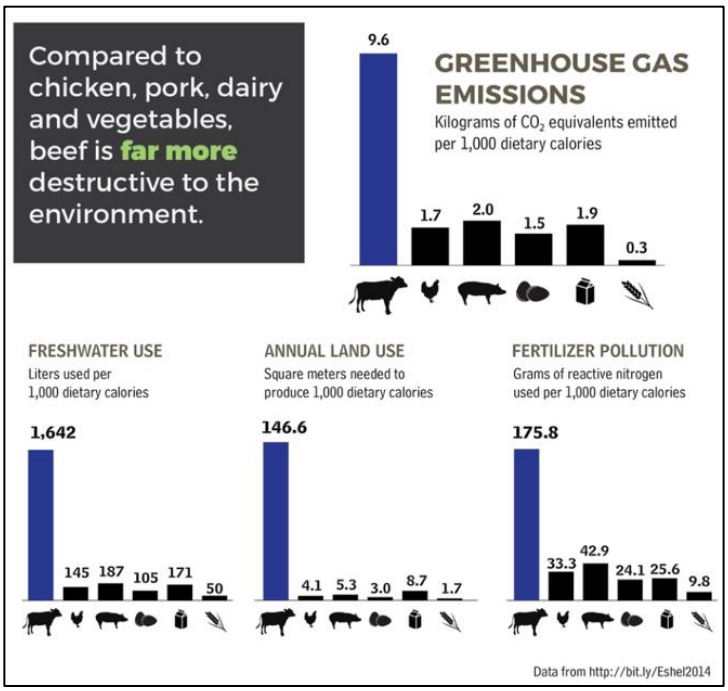

Figure 1: Graphic from holdthebeef.org

Step 2: Calculate carbon footprint of 6 common American meals

After finding sufficient research to support my claim that diet plays a significant part in an individual's carbon emission profile, I set out to calculate the carbon footprint of 6 common

[10] The Sustainability Secret." COWSPIRACY. Accessed December 11, 2019. https://www.cowspiracy.com/facts?fbclid=IwAR1hF5Du9KPXMbBOJQmI_mcs3Vf0anos2ORlx5i_zL-5YPo5zpuataMtLGY.
[11] Ibid.

American meals. My goal was to show viewers the emission profile of each ingredient found in a meal they might come across, so that the next time they were faced with a meal decision, they would hopefully factor carbon emissions into their selection process. While the origin of an ingredient can result in different emission profiles (grain fed wagyu beef flown in from Japan has a higher carbon footprint than local beef), my goal was to illustrate the greenhouse gas footprint of an average ingredient. For the sake of consistency, I used data from the March 2017 report by the Natural Resources Defense Council: Less Beef, Less Carbon[12]. In order to handle emission ranges and ingredient weight ranges, I took the average of the high and low end of the provided range.

The six food items I chose to analyze were: cheeseburger, chicken caesar salad, bowl of cereal, chips and guacamole, over-easy egg, and a slice of pepperoni pizza. I chose these specific food items because of their prevalence at either breakfast, lunch, and dinner in the United States. I started my analysis by finding recipes for each food item. Below, I detail the methodology I employed to determine the greenhouse gas emission of a meal:

1. Convert units of each ingredient into kilograms
2. Multiply this by the carbon emissions factor presented in the NRDC report
3. Use other online resources to ascertain the carbon emissions factor of an ingredient if the emissions information was not provided by the NRDC report
4. Normalize to a one person serving size

[12] "LESS BEEF, LESS CARBON: AMERICANS SHRINK THEIR DIET-RELATED CARBON FOOTPRINT BY 10 PERCENT BETWEEN 2005 AND 2014 ." LESS BEEF, LESS CARBON: AMERICANS SHRINK THEIR DIET-RELATED CARBON FOOTPRINT BY 10 PERCENT BETWEEN 2005 AND 2014 , 2017.

5. Sum the individual greenhouse gas emissions of each ingredient to arrive at a sum-of-parts total carbon footprint for each meal

In making these calculations, I assumed that ingredients such as salt and pepper, etc. had no carbon footprint. Unless noted by an explicit footnote, all emission factors in this report were taken from the NRDC report. After calculating the greenhouse gas emissions from each food, I proceeded to use the EPA's greenhouse gas calculator[13] to frame the emissions impact of each meal in terms of miles driven in an average passenger van and carbon dioxide emissions from five pounds of burned coal. While it is more abstract to consider the long journey a piece of steak has undergone to arrive on a plate, it is not difficult to equate that to driving a given number of miles. Below, I present my findings for each of the 6 foods:

Cheeseburger recipe[14]:

- Freshly ground chuck patty: $\frac{5.33\ ounces}{1\ burger\ patty} \times \frac{1\ kg}{35.27\ ounces} \times \frac{26.45\ kg\ CO_2}{1\ kg\ of\ beef} = 4.00 kg\ CO_2$
- 1 slice of American cheese: $\frac{0.6\ ounces}{1\ slice\ of\ cheese} \times \frac{1\ kg}{35.27\ ounces} \times \frac{9.78\ kg\ CO_2}{1\ kg\ of\ cheese} = 0.17 kg\ CO_2$
- Lettuce: $\frac{0.3\ ounces}{1\ lettuce\ leaf} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.08\ kg\ CO_2}{1\ kg\ of\ lettuce} = 0.01 kg\ CO_2$
- Tomato[15]: $\frac{0.7\ ounces}{1\ tomato\ slice} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.18\ kg\ CO_2}{1\ kg\ of\ tomato} = 0.02 kg\ CO_2$
- Burger bun[16]: $\frac{2.25\ ounces}{1\ hamburger\ bun} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.18\ kg\ CO_2}{1\ kg\ of\ bread} = 0.07 kg\ CO_2$
- **Total:** $\mathbf{4.00 + 0.17 + 0.01 + 0.02 + 0.07 = 4.27 kg\ CO_2}$

[13] "Greenhouse Gas Equivalencies Calculator." EPA. Environmental Protection Agency, October 15, 2018. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
[14] Republic, Food. "All-American Cheeseburger Recipe." Food Republic, March 27, 2012. https://www.foodrepublic.com/recipes/all-american-cheeseburger-recipe/.
[15] Page, Girija, Brad Ridoutt, and Bill Bellotti. "Carbon and Water Footprint Tradeoffs in Fresh Tomato Production." Journal of Cleaner Production 32 (September 2012): 219–26. https://doi.org/10.1016/j.jclepro.2012.03.036.
[16] Espinoza-Orias, Namy, Heinz Stichnothe, and Adisa Azapagic. "The Carbon Footprint of Bread." The International Journal of Life Cycle Assessment 16, no. 4 (2011): 351–65. https://doi.org/10.1007/s11367-011-0271-0.

- Equivalent to greenhouse gas emissions from 11 miles driven by an average passenger van or carbon dioxide emissions from 5 pounds of burned coal

Chicken caesar salad recipe[17]:

- Parmesan cheese: $\frac{0.25\ cup}{1\ parmesan\ cheese} \times \frac{8\ ounces}{1\ cup} \times \frac{1\ kg}{35.27\ ounces} \times \frac{9.78\ kg\ CO_2}{1\ kg\ of\ cheese} = 0.55 kg\ CO_2$
- Romaine lettuce head: $\frac{22\ ounces}{1\ romaine\ lettuce\ head} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.08\ kg\ CO_2}{1\ kg\ of\ romaine\ lettuce} = 0.67 kg\ CO_2$
- Chicken breast: $\frac{4\ ounces}{1\ chicken\ breast} \times \frac{1\ kg}{35.27\ ounces} \times \frac{5.05\ kg\ CO_2}{1\ kg\ of\ chicken\ breast} = 0.57 kg\ CO_2$
- Focaccia croutons[18]: $\frac{2\ ounces}{1\ slice\ of\ focaccia\ bread} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.11\ kg\ CO_2}{1\ kg\ of\ bread} = 0.06 kg\ CO_2$
- Lemon juice[19]: $\frac{1\ ounce}{1\ lemon} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.11\ kg\ CO_2}{1\ kg\ of\ lemon} < 0.01 kg\ CO_2$
- **Total:** $\mathbf{0.55 + 0.67 + 0.57 + 0.06 = 1.85 kg\ CO_2}$
- Equivalent to greenhouse gas emissions from 4.3 miles driven by an average passenger van or carbon dioxide emissions from 2 pounds of burned coal

Cereal:

- 1% Milk: $\frac{1\ ounce}{1\ bowl\ of\ 1\%\ milk} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.34\ kg\ CO_2}{1\ kg\ of\ milk} = 0.04 kg\ CO_2$
- Cereal[20]: $\frac{1\ ounce}{1\ serving\ of\ cereal} \times \frac{1\ kg}{35.27\ ounces} \times \frac{0.98\ kg\ CO_2}{1\ kg\ of\ cereal} = 0.03 kg\ CO_2$
- **Total:** $\mathbf{0.04 + 0.03 = 0.07 kg\ CO_2}$
- Equivalent to greenhouse gas emissions from 0.2 miles driven by an average passenger van or carbon dioxide emissions from 0.01 pounds of burned coal

[17] Kitchen, Food Network. "Grilled Chicken Caesar Salad." Food Network. Food Network, June 9, 2014. https://www.foodnetwork.com/recipes/food-network-kitchen/grilled-chicken-ceasar-salad-recipe-2118200.
[18] Ibid.
[19] "Food Product Environmental Footprint Literature Summary." Food Product Environmental Footprint Literature Summary, n.d.
[20] Chaudhary, Abhishek, Christopher Marinangeli, Denis Tremorin, and Alexander Mathys. "Nutritional Combined Greenhouse Gas Life Cycle Analysis for Incorporating Canadian Yellow Pea into Cereal-Based Food Products." Nutrients 10, no. 4 (2018): 490. https://doi.org/10.3390/nu10040490.

Chips and Guacamole[21]:

- Avocado[22]: $5\ avocados \times \frac{0.5\ kg}{1\ avocado} \times \frac{0.43\ kg\ CO_2}{1\ kg\ of\ avocado} \times \frac{1}{8\ servings} = 0.27 kg\ CO_2$
- Red onion[23]: $\frac{1}{2} red\ onion \times \frac{6\ ounces}{1\ red\ onion} \times \frac{1\ kg}{35.27\ ounces} \times \frac{0.17\ kg\ CO_2}{1\ kg\ of\ onion} \times \frac{1}{8\ servings} < 0.01\ kg\ CO_2$
- Lime juice[24]: $\frac{1.55\ ounces}{1\ lime} \times \frac{1\ kg}{35.27\ ounces} \times \frac{0.17\ kg\ CO_2}{1\ kg\ of\ lime} \times \frac{1}{8\ servings} < 0.01 kg\ CO_2$
- Tortilla chips[25]: $\frac{16\ ounces}{1\ bag\ of\ tortilla\ chips} \times \frac{50\ grams\ CO_2}{1.5\ ounces\ of\ tortilla\ chips} \times \frac{1\ kg}{1000\ grams} \times \frac{1}{8\ servings} = 0.07 kg\ CO_2$
- **Total:** $\mathbf{0.27 + 0.07 = 0.34 kg\ CO_2}$
- Equivalent to greenhouse gas emissions from 0.83 miles driven by an average passenger van or carbon dioxide emissions from 0.37 pounds of burned coal

Over-easy egg:

- Egg[26]: $\frac{1\ dozen\ eggs}{12\ eggs} \times \frac{2.7\ kg\ CO_2}{1\ dozen\ eggs} = 0.23 kg\ CO_2$
- **Total:** $\mathbf{0.23 kg\ CO_2}$
- Equivalent to greenhouse gas emissions from 0.56 miles driven by an average passenger van or carbon dioxide emissions from 0.25 pounds of burned coal

Slice of pepperoni pizza[27]:

- Mozzarella cheese: $\frac{8\ ounces}{1\ mozzarella\ cheese} \times \frac{1\ kg}{35.27\ ounces} \times \frac{9.78\ kg\ CO_2}{1\ kg\ of\ cheese} \times \frac{1}{8\ slices} = 0.28 kg\ CO_2$

[21] Quessenberry, Sara. "Guacamole and Chips." Real Simple, May 8, 2007. https://www.realsimple.com/food-recipes/browse-all-recipes/guacamole-chips.
[22] Powell, Tom. "Revealed: the Enormous Carbon Footprint Linked to Eating Avocado." Evening Standard, July 19, 2017. https://www.standard.co.uk/news/uk/revealed-the-enormous-carbon-footprint-linked-to-eating-avocado-a3591501.html.
[23] staff, Science X. "New Study Provides Food Carbon Footprint Pecking Order." Phys.org. Phys.org, November 2, 2016. https://phys.org/news/2016-11-food-carbon-footprint.html.
[24] "Food Product Environmental Footprint Literature Summary: Citrus." Food Product Environmental Footprint Literature Summary: Citrus, n.d.
[25] Reay, Dave. "Climate-Smart Maize." Climate-Smart Food, June 26, 2019, 135–47. https://doi.org/10.1007/978-3-030-18206-9_11.
[26] McDougal, Tony. "Environmental Footprint of the Egg Industry Revealed." PoultryWorld, April 6, 2018. https://www.poultryworld.net/Eggs/Articles/2018/4/Environmental-footprint-of-the-egg-industry-revealed-268882E/.
[27] Sayles, Fatima Melicor, Zackery Gurley, and Sherry. "Homemade Pepperoni Pizza Recipe." Allrecipes, December 14, 2014. https://www.allrecipes.com/recipe/240376/homemade-pepperoni-pizza/.

- Pepperoni: $(\frac{28\ ounces}{1\ pork} \times \frac{6.87\ kg\ CO_2}{1\ kg\ of\ pork} + \frac{12\ ounces}{1\ beef} \times \frac{26.45\ kg\ CO_2}{1\ kg\ of\ beef}) \times \frac{1\ kg}{35.27\ ounces} \times \frac{1}{8\ slices} = 1.8kg\ CO_2$
- Tomato paste[28]: $\frac{80\ ounces}{tomatoes} \times \frac{1\ kg}{35.27\ ounces} \times \frac{1.18\ kg\ CO_2}{1\ kg\ of\ tomato} \times \frac{1}{8\ slices} = 0.33kg\ CO_2$
- Pizza dough[29]: $\frac{27\ ounces}{flour} \times \frac{1\ kg}{35.27\ ounces} \times \frac{0.61\ kg\ CO_2}{1\ kg\ of\ flour} \times \frac{1}{8\ slices} = 0.06kg\ CO_2$
- **Total:** $\mathbf{0.28 + 0.9 + 0.33 + 0.06 = 1.57kg\ CO_2}$
- Equivalent to greenhouse gas emissions from 3.8 miles driven by an average passenger van or carbon dioxide emissions from 1.7 pounds of burned coal

Step 3: Website design

There are many existing environmental awareness websites that are overly cluttered, and provide dense amounts of information that is hard to digest. This limits the website's appeal to viewers who are not actively seeking to learn about climate change or greenhouse gas emissions. My goal was to design a lightweight, visually appealing website that was able to convey my research to a broad range of audiences. I wanted my website to act as a primer on how a carbon conscious diet can significantly reduce carbon emissions. I hoped to create a platform that could not only educate first time viewers, but also provide a set of additional resources for anyone who wanted to go a step further and examine my research materials. My website is divided into the following sections:

I. **Home/Landing page:**

This page serves as a call to action. The goal is to capture the viewer's attention and immediately let them know that they can be part of the solution. I think letting viewers

[28] Page, Girija, Brad Ridoutt, and Bill Bellotti. "Carbon and Water Footprint Tradeoffs in Fresh Tomato Production." Journal of Cleaner Production 32 (September 2012): 219–26.
[29] Chaudhary, Abhishek, Christopher Marinangeli, Denis Tremorin, and Alexander Mathys. "Nutritional Combined Greenhouse Gas Life Cycle Analysis for Incorporating Canadian Yellow Pea into Cereal-Based Food Products." Nutrients 10, no. 4 (2018): 490. https://doi.org/10.3390/nu10040490.

know that they can make a difference will motivate them to further explore the webpage and learn.

II. Environmental impact of meat, dairy and vegetables page:

The goal of this page is to show viewers that different types of animal protein have different greenhouse gas emission, land use, and water use profiles. In order to visually convey this, I built dynamic sliders for each type of meat, dairy and a plant based diet. These sliders will display greenhouse gas emissions (kg CO_2 equivalent), land use (m_2), and water use (liters) per 1000 dietary calories. Additionally, I colored the sliders either green (low), yellow (medium), orange (medium/high), or red (high) depending on degree of environmental impact.

An important concept that I hope viewers will pick up on is the fact that in addition to emissions from the animal itself, a large component of environmental impact is due to feed production for animal agriculture. Ideally, viewers are able to quickly understand that animals such as beef cattle are more inefficient at converting feed into protein, and thus place a greater burden on the planet.

Another big takeaway from this page is that beef cattle emit more greenhouse gasses, and use substantially more land and water during production than any other protein source. This should incentivize viewers to be more carbon conscious the next time that they are deciding between a beef and poultry/pork entree. I hope this section also encourages more people to try eating vegetarian or vegan food due to their significant environmental

advantages. Even deciding to be vegan for a day saves 1100 gallons of water, 45 pounds of grain, and 20 pounds of carbon dioxide equivalent[30].

III. Carbon footprint of different meals page:

The goal of this page is to give viewers a quick peek into how their diet choices directly affect their carbon emissions footprint. My design choice is to have cartoon pictures of all six foods and have carbon dioxide emission facts and carbon emission equivalents for each ingredient popup on top of the image when the viewer hovers over the it. I don't want to overwhelm viewers on this page with numbers or text, so I put my calculations on a separate page. Hopefully, a website visitor hovers over the picture of the cheeseburger and the chicken caesar salad and is able to quickly see that the cheeseburger has higher CO_2 equivalent emissions because beef has a high emission factor. For each image, I created a button that links to the *Methodology and Calculations* page so that viewers can see that these calculations are rooted in facts.

IV. Methodology and Calculations page:

Sometimes, informational websites will put out numbers that are not supported by sources or calculations. I think that this significantly detracts from the website's credibility. My goal in this section is to supplement the numbers I cite in the *Carbon footprint of different meals* page. For each meal calculation, I will include footnotes to recipes and carbon emissions data and the full derivation of kg CO_2 calculations.

[30] "The Sustainability Secret." COWSPIRACY. Accessed December 11, 2019. https://www.cowspiracy.com/facts?fbclid=IwAR1hF5Du9KPXMbBOJQmI_mcs3Vf0anos2ORlx5i_zL-5YPo5zpuataMtLGY.

V. About page:

In this section I wanted to detail the goal of the website as well as share my story and motivation for creating it. Prior to taking 6.S898, I was not very concerned about climate change. As a collegiate athlete, my diet normally consisted of foods high in protein content. Being carbon conscious in my diet selection never crossed my mind, but as I read more about the animal agriculture industry and learned more about carbon emissions, I realized that trying to adopt a carbon conscious diet can make a large impact, and it is something every individual should strive to do.

VI. Additional references page:

In this part of the website, I wanted to share resources that helped me learn more about the impacts of the animal agriculture industry and climate change in general. This section will be tailored towards individuals who are actively seeking to learn more. I will list online resources, books, and documentaries that I found impactful.

Step 4: Implementation

I created my website using a combination of HTML, CSS and JavaScript. Please refer to my GitHub repository to look at the code base[31]. I think that building the website from scratch has certain advantages over using either Wix or Squarespace. First and foremost, I think building it out myself will allow me to modify or add on to the website in the future as I learn more about climate change. Secondly, I am hoping to make the GitHub repository public and allow anyone from the class to contribute if they want to.

[31] https://github.com/jxiang1997/jxiang1997.github.io

Step 5: Share website

Through Amazon Route 53, I am hosting my website with the domain name www.ediblecarbon.net. I am hoping to share my website across social media platforms in order to spread awareness about how carbon conscious diets can mitigate carbon emissions. In the modern day and age, social media advertising is very powerful and I am hoping to take advantage of this.

Contributions:

1. Aggregated prior research from various websites, reports, documentaries, and books pertaining to greenhouse gas emissions, land use, and water use of beef cattle, poultry, pork, dairy and plant-based diets
2. Calculated the carbon footprint for six common American meals by researching the carbon emission factor for each ingredient and scaling them appropriately to fit the serving size of the meal.
3. Created website from scratch using HTML, CSS, and JavaScript to present research findings in an easily digestible manner.
4. Provided additional resources for interested website visitors to learn more about animal agriculture and climate change.
5. Shared website on social media in order to spread awareness.

Future work:

1. Refactor code base to improve dynamic sizing of images
2. Modify source code so that it is compatible with mobile browser
3. Calculate carbon footprint of more meals
4. Create section with restaurant reviews to promote vegan or other sustainable restaurants

Works Cited

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