



Carbon Negative:  
Reducing Dining's  
Carbon Footprint  
at Penn State

A 2020 Drawdown  
Scholars Research  
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## Abstract

Diet is an often unrecognized, but large contributor to our carbon footprint. An average American diet has a carbon footprint of 1.72 metric tons of CO<sub>2</sub>-eq every year,<sup>1</sup> which means that approximately 130,000 metric tons of CO<sub>2</sub>-eq are emitted by all 77,000 Penn State undergraduate enrolled across the commonwealth. At 14,000+ students living on just University Park campus, PSU Dining essentially feeds a small city. The strategies to lower our carbon footprint through dining choices chiefly center around eating more plant-based foods, sourcing food locally, reducing food waste, and using alternative materials for to-go containers.

Penn State Dining Services already has the infrastructure to implement a number of strategies; however, the majority are underutilized. The reasons for this are cost, an already established culture, lack of student and dining staff engagement, and lack of education. This study analyzed the efficacy of additional sustainability solutions that can be promoted at Penn State. This study examined Penn State's dining infrastructure to find areas of opportunity for more sustainable operations by conducting staff interviews, reviewing data from Dining Services, as well as reflecting on personal experiences from eating in the University Park dining halls for two years. The study also compared and contrasted PSU Dining sustainability programs with other large universities and analyzed the feasibility of strategies that have been proposed to PSU Dining in the past, but never implemented. An analysis of the three-week menu cycle from Spring 2016 to Fall 2020 was performed to gauge how many plant-based options were provided over time. In addition, a cost analysis of the to-go container options was performed using previously acquired data and literature values. Finally, purchasing data was used to calculate the current carbon impact of PSU Dining's beef and pork acquisitions.

These analyses found several ways to lower the carbon footprint of dining at Penn State including: implementing trayless dining in the dining halls; starting a Meat "less" Mondays program; creating more plant-based signage; increasing the dietary completeness and taste of plant-based entrees; sourcing food locally; standardizing sustainability initiatives across the commonwealth; and reducing food insecurity through a partnership with Lion's Pantry and the library. The findings of this study will be presented to Dining in the form of a report as well as continuation of the project through the Carbon Negative Solutions program at Penn State. Although some of these findings and recommendations may not be able to be implemented immediately next semester due to current social distancing restrictions, they can begin to be piloted in Spring 2021.

**Carbon Negative:** Penn State has pledged to cut its Carbon emissions 80% by 2050, as compared to its 1990 baseline.<sup>2</sup> This decision was made in 2005. However, the latest report from the International Panel on Climate Change in 2018 says that we must reach net zero by 2050 in order to stave off the absolute worst effects of climate change.<sup>3</sup> Penn State faculty, staff, and students believe that we, as a leading research and innovation university, can do better than that. In order to do so, we must tackle our carbon emissions in every part of our lives and challenge the way that we have designed our systems so that we can assess our impacts and learn how to reduce them. We must ask ourselves—what are our priorities and how do we match our spending to meet them?

## BACKGROUND

Diet is an often unrecognized, but major contributor to our carbon footprint; an average American diet can have a carbon footprint of 1.72 metric tons of CO<sub>2</sub>-eq every year.<sup>1</sup> The types of food you eat and where you source them from can impact the carbon footprint of your diet greatly. Agriculture is responsible for one-quarter of the world's greenhouse gas emissions—dominated by the production of animal-based foods.<sup>4</sup> Food agriculture takes up about 38% of the land usage globally and about two-thirds of freshwater withdrawals globally.<sup>5</sup>

### Plant-Based Diets

Eating a plant-based diet is one of the most significant ways to lower the carbon footprint of diet. Meat, especially beef, has a large environmental impact. When including land use, eutrophication, energy use, greenhouse gas (GHG) emissions, and acidification potential, animal agriculture has an environmental impact 100 times greater than plant agriculture.<sup>6</sup> Unsustainable livestock production makes up the bulk of agriculture's environmental cost due to high resource use as well as biodiversity loss and carbon emissions.<sup>7</sup> Beef is only 4% of the US food supply, but it emits 36% of the diet-related GHGs.<sup>8</sup> If cattle were their own nation, they would be the world's third-largest emitter of GHGs.<sup>9</sup> Beef is also one of the most inefficient sources of animal protein<sup>[10]</sup> in terms of how much protein can be generated per feed input, as shown in Figure 1. Penn State currently purchases more than 97,000 lbs of beef every year, contributing to the demand for beef and increasing the carbon footprint of our Dining program as a whole.

Beef Is One of the Most Inefficient Sources of Calories and Protein

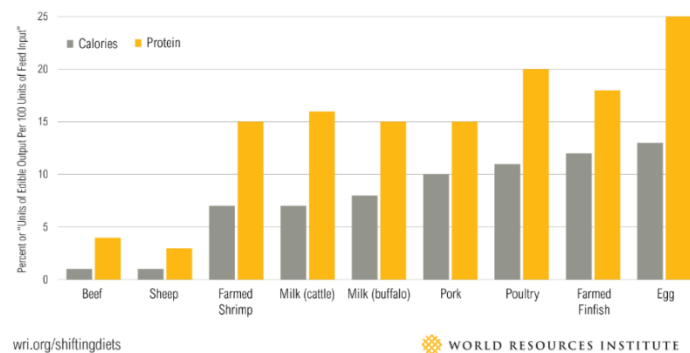


Figure 1. Graph of multiple protein sources by calories and protein amounts per 100 units of feed input. Sourced from: <https://www.wri.org/blog/2016/04/sustainable-diets-what-you-need-know-12-charts>

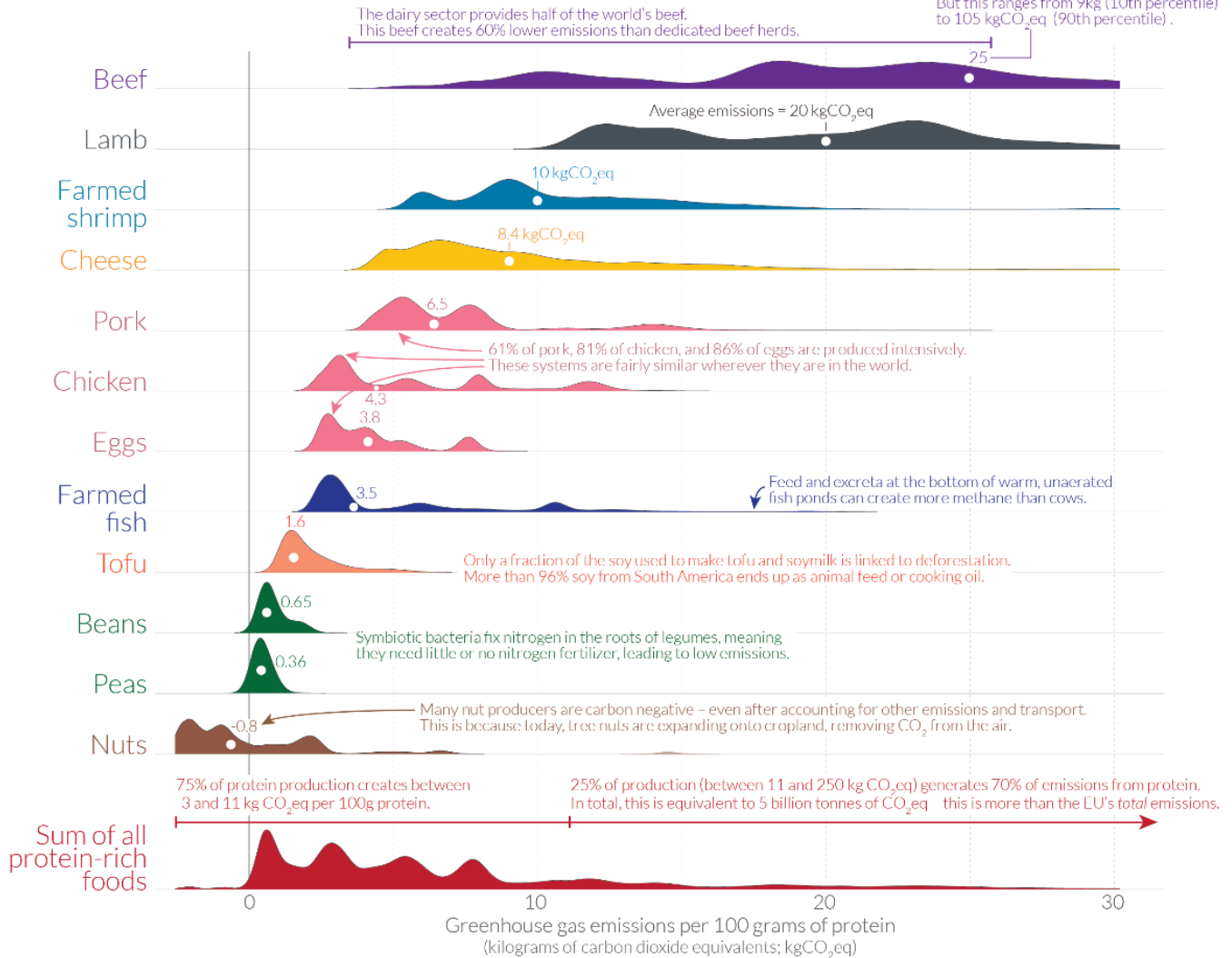
Figure 2 shows the carbon footprint of various protein sources, across a global sample of production. It's clear to see that beef is one of the most carbon-intensive sources of protein. Moving down the list from animal-based proteins to plant-based proteins, the carbon impact decreases significantly, going from an average of 25 kg of CO<sub>2</sub>-eq for beef to -0.8 kg of CO<sub>2</sub>-eq for nuts.

# How does the carbon footprint of protein-rich foods compare?

Greenhouse gas emissions from protein-rich foods are shown per 100 grams of protein across a global sample of 38,700 commercially viable farms in 119 countries.

The height of the curve represents the amount of production globally with that specific footprint. The white dot marks the median greenhouse gas emissions for each food product.

Producing 100 grams of protein from beef emits 25 kilograms of CO<sub>2</sub>eq, on average. But this ranges from 9kg (10th percentile) to 105 kgCO<sub>2</sub>eq (90th percentile).



Note: Data refers to the greenhouse gas emissions of food products across a global sample of 38,700 commercially viable farms in 119 countries. Emissions are measured across the full supply chain, from land use change through to the retailer and includes on farm, processing, transport, packaging and retail emissions. Data source: Joseph Poore and Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*. OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the authors Joseph Poore & Hannah Ritchie.

Figure 2. Graph showing carbon footprints of multiple protein sources  
 Sourced from: <https://www.wri.org/blog/2016/04/sustainable-diets-what-you-need-know-12-charts>

Switching our diets from beef to poultry would reduce emissions by more than 50%. Switching our diets from meat-based protein sources to plant-based protein sources would reduce emissions by about 80%, as shown in Figure 3

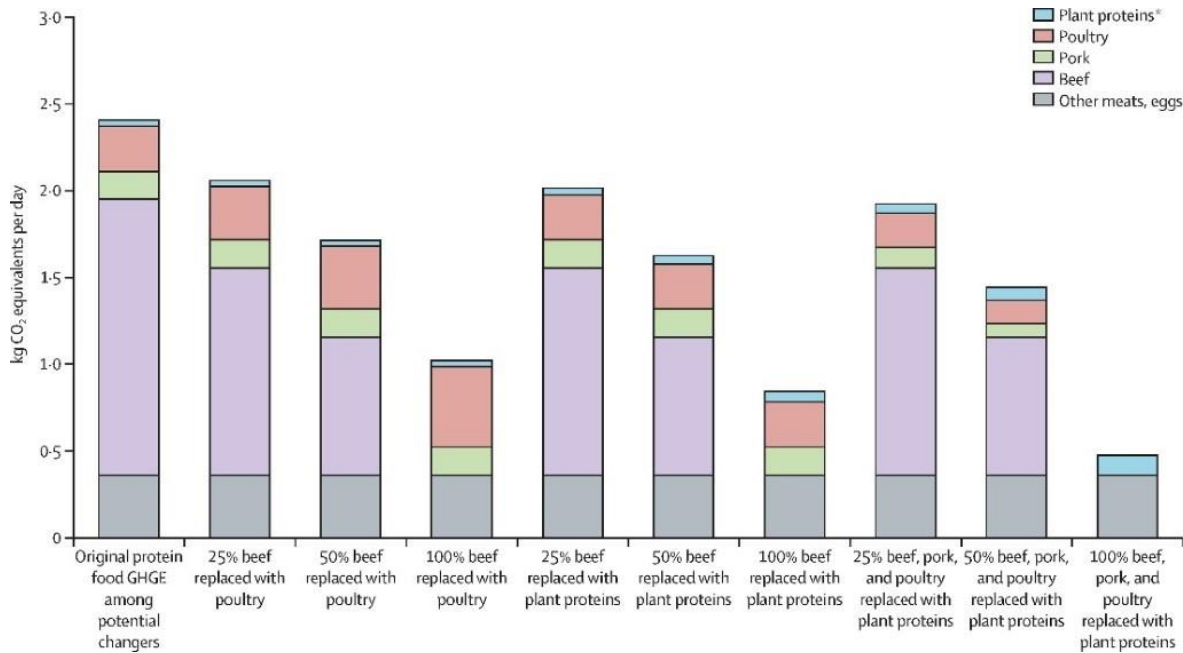


Figure 3. Chart showing the decrease in carbon impact from varying diets with different amounts of beef, pork, poultry, and plant proteins.

Sourced from: <https://www.sciencedirect.com/science/article/pii/S2542519620300553>

There is broad scientific data to show that eating a diet high in animal-based products leads to adverse health effects. Overconsumption of red meat, as is common in the US, has been linked diseases such as coronary heart disease, type 2 diabetes, obesity, and cancer.<sup>6</sup> Further, excessive antibiotic use in livestock has been found to increase antibiotic resistance in humans, too, decreasing the effectiveness of modern medicine to fight disease.<sup>10</sup> Livestock have also contributed to the spreading of animal borne diseases, especially to farmers who work in close contact with them.

The most common misconception is that switching from an animal-based diet to a plant-based diet will create protein deficiencies. However, Americans are already overconsuming protein anyway. On average, Americans consume 40 more grams of protein per day than recommended by nutritional guidelines, or essentially double the protein requirement. Further, about 60% of the recommended daily protein

#### People Are Eating More Protein than They Need—Especially in Wealthy Regions

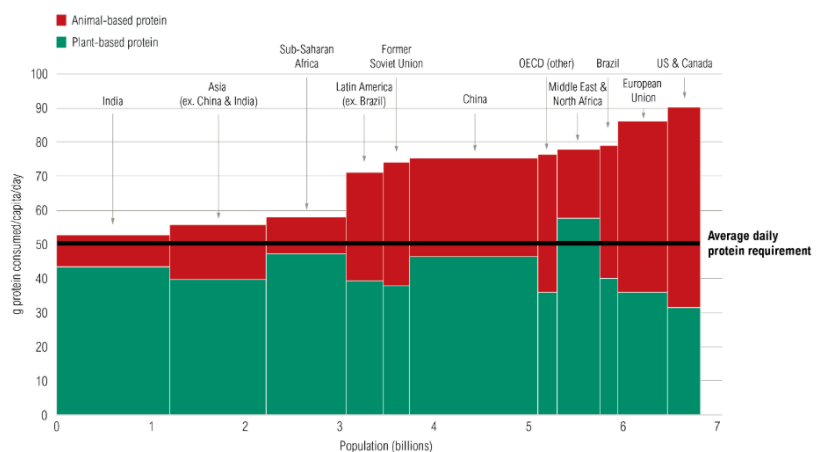


Figure 4. Graph depicting the recommended daily protein intake with the average amount of protein actually consumed by country

intake already comes from plant-based sources. This means that the remaining gap can be filled by just eating one 3oz. chicken breast or 1 cup of lentils to meet the recommended requirements.

Further, plant-based diets are actually *cheaper* than animal-based diets. A study showed that replacing all the meat with plant-based protein in an average American's diet led to a 10.5% decrease in food costs.<sup>11</sup> This means that Penn State can save money by shifting to plant-based products. Additionally, animal agriculture is heavily subsidized by the government, so the true cost of the food is higher than reflected at the market, leading to economic losses that are not easily seen. Negative externalities of health and environmental costs factor into food production. This includes medical care for diet-related diseases as well as the cost of pollution cleanup due to animal excretions. We don't see these costs reflected in the price tag we pay to buy this food. If health care costs were included in the price of meat, processed meat prices would increase over 100% in the US.<sup>12</sup>

### **Buying local**

Buying local foods can greatly decrease the environmental footprint of that food because it does not have to be transported from long distances, as any method of food transportation used currently releases GHGs. Eating foods that are out of season, or specialty food that must be flown in from other countries, can impact the footprint of that food by 90%.<sup>13</sup> Penn State currently buys only 16-18% of food from Pennsylvania manufacturers and growers, and this percentage could increase by prioritizing buying from local suppliers.

Reducing vehicle emissions can greatly benefit public health. By not flying and trucking in out of season foods, we cut down on particulate emissions and GHGs such as CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>x</sub> from jet fuel. Reduced air pollution is especially important during a global pandemic with a respiratory illness, as air pollution exacerbates the illness. Lowering the carbon footprint of our dining services by buying local helps us to lower our climate impact overall. Doing so can help slow climate change, which has already started to show impacts. In Pennsylvania alone, we see stronger storms and more flooding, heat waves, and booming tick populations. These weather pattern changes and associated impacts more directly affect poorer Pennsylvanians and communities of color.

### **Food Waste**

If food waste were its own county, it would be the third highest GHG emitter.<sup>14</sup> Food waste accounts for 8% of global emissions, as about a third of food that we produce never makes it to our tables.<sup>15</sup> This not only wastes the food itself, but also the labor, resources, and carbon emissions it took to grow and transport the food. Reducing food waste is the number three drawdown solution to cut carbon emissions globally. In higher-income countries, the way to address it is by major interventions at the retail and consumer level.



The Food and Agriculture Organization of the United Nations estimates that globally, food waste accounts for 1 trillion USD of economic losses.<sup>16</sup> Unfortunately, Penn State is a contributor to this loss. In just Fall 2019 alone, PSU Dining halls at University Park wasted almost 265,000 lbs of food, totaling to about \$369,000 of monetary loss. By avoiding this waste, we would save enough money to provide full tuition scholarships to 20 in-state students or fully fund 150 students' Level 2 meal plans. As shown in Figure 5, about three-fourths of the food waste occurs due to food thrown out by students when they have finished their meal, and prepared food set out on the service line that was out for too long or left over at the end of the meal period.



Figure 5. Top reasons for food waste at University Park as per LeanPath

This means that the way to reduce food waste the most is to incentivize students to take less food, eat what they take, and strategize how to reduce the amount of food out on the line. When the meal period is over, the food on the line is composted. This is because of university food safety standards. These standards currently prevent the dining hall from giving that food away, which contributes greatly to the amount of waste. Unless the university changes its food standards, perfectly fine food from the end of meal periods will continue to be wasted.

### To-Go Materials

The way that we package our food contributes to the carbon footprint of the overall meal. PSU Dining has a to-go options at all meals, and thus the food must be taken out in some type of container. Currently, we have a single-use polystyrene (i.e. styrofoam) option and a reusable polypropylene options shown in Figure 6 (i.e. Green2Go or G2G).

The Green2Go program aims to reduce the amount of polystyrene we consume and send to the landfill. Any student who eats to-go form the dining hall can avail this option. When entering the dining hall, the student pays a \$5 refundable deposit to a cashier who gives them a Green2Go box. The student can fill up their box and take it. When the student returns to the dining hall the next time, they can bring the dirty box back and drop it off for cleaning in exchange for a clean G2G box or a carabiner which serves as a G2G token. At the end of the



Figure 6. A polypropylene Green2Go clamshell filled with food  
Sourced from: <https://sites.psu.edu/zoeypsu17/2014/04/25/blog-8/>



semester, the student can return the box to the dining hall to receive the \$5 deposit back. Students are also incentivized to participate in this program with a free meal punch card—for every 9 meals taken in a Green2Go, the 10<sup>th</sup> meal is free.

The G2G serves as a more sustainable alternative to polystyrene, a material that has long been recognized as harmful to the environment and human health. Polystyrene can only be used once before it's sent to the landfill, where it takes over 500 years to decompose. While recycling polystyrene is possible, there are very limited options. Penn State attempted to enter a polystyrene recycling program from 2012 to 2016. However, from the polystyrene Penn State collected, the food contamination was too high and the mass was too low for a recycler to accept it.<sup>17</sup> Moreover, polystyrene, while an inexpensive and lightweight material, is far more expensive to the environment and both worker and consumer health due to benzene, ethylene, and styrene exposure. Styrene has been a long-suspected carcinogen and can leach from polystyrene products, which is why it is harmful for food to be in prolonged contact with it before being consumed.<sup>18</sup>

## ANALYSES

### Menu Analysis

The American public, especially younger Americans, is becoming aware of the negative health and environmental impacts of animal-based diets. Accordingly, students are increasingly turning to more plant-based diets, over traditional American meat-based diets. However, this trend has not been reflected in the menu choices that Penn State Dining offers. In the past 5 years, the number of meatless (including vegan) options provided in a three-week menu cycle, across lunch and dinner, has stayed relatively constant, as shown in Figure 7.

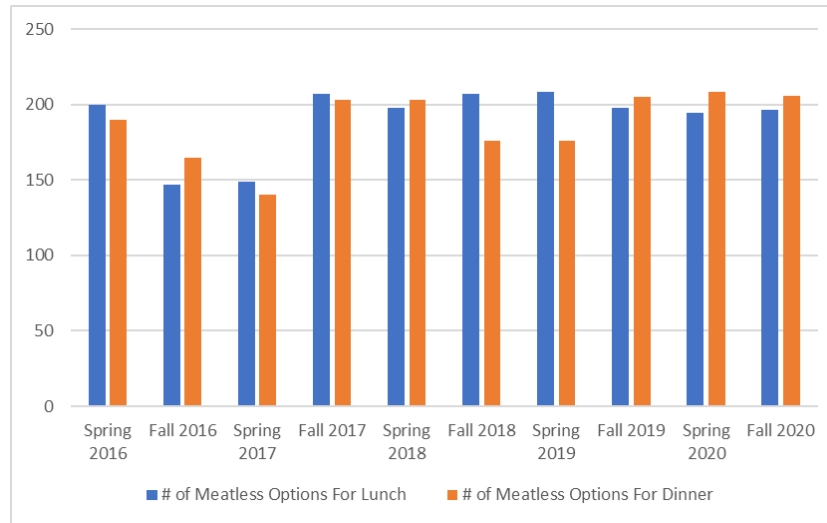


Figure 7. This chart was created from the three-week menu cycle by counting the number of designated meatless and vegan options available for lunch and dinner.

At every meal, there is at least one vegan soup choice and one vegan entrée served as an “other” option; but this is only one portion of a larger menu. If Penn State offered 50% of menu options as vegetarian/vegan, that would imply that plant-based options are “normal” rather than “special”, encouraging a shift in attitude.<sup>19</sup>

### To-Go Container Analysis

A comparative analysis was performed on the GHG emission impacts of expanded polystyrene (i.e., styrofoam) clamshells versus Green2Go polypropylene plastic clamshells based on the monetary cost to Penn State and the social cost of GHG emissions. As per the EPA, the social cost of carbon is a measure, in dollars, of the long-term damage done by a ton of carbon dioxide emissions in a year including changes in agricultural productivity, human health, property damages, and changes in energy system costs.<sup>20</sup> The GHG emissions of the expanded polystyrene is about 3.14 kg CO<sub>2</sub>-eq/kg polystyrene, leading to a hidden social cost of about \$177 for a semester’s worth of polystyrene. The GHG emissions of the polypropylene clamshells is about 3.5 kg CO<sub>2</sub>-eq /kg polystyrene, leading to a hidden social cost of about \$115 for a semester’s worth of polystyrene. These calculations are shown below.

**Single Use Polystyrene (Styrofoam)**

Assumptions:

Weight: 7.4lb/200 boxes = 0.037lb/box = 54,054 boxes/US ton

Cost: \$0.06/box

Volume: 80,000 to-go meals/semester

Transport to landfill: 0.01018 metric tons CO<sub>2</sub> emitted from burning one gallon of diesel,<sup>22</sup> 4.4 mpg average for a refuse truck,<sup>23</sup> 70 miles to the landfill, \$75/ton paid to put one ton of refuse into the landfill

Social Cost of Carbon: \$42/metric ton CO<sub>2</sub><sup>21</sup>

GHG emissions: 3.14 kg CO<sub>2</sub>-eq emitted/kg polystyrene<sup>24</sup>

<b>Weight of one semester of polystyrene</b>	80,000 boxes * 0.037lb/box* 0.45 kg/lb	1342.63 kg
<b>Total emissions for semester</b>	1342.63 kg of polystyrene*3.14 kg CO <sub>2</sub> -eq emitted/kg polystyrene	4215.87 kg
<b>Social cost of CO<sub>2</sub></b>	4215.87 kg*\$42/metric ton CO <sub>2</sub> social cost/1000 kg per metric ton	\$177
<b>Cost of the boxes to PSU</b>	80,000 boxes * \$0.06/box	\$4,800.00
<b>Cost of Landfill Disposal</b>	1342.63 kg/907 kg per US ton*\$75/ton+(70 mi to landfill/4.4mpg for truck) * 0.01018 metric tons CO <sub>2</sub> emitted from burning one gallon of diesel*\$42/metric ton CO <sub>2</sub>	\$117.80
<b>Total Cost</b>		<b>\$5,095</b>

**Reusable Polypropylene Plastic (Green2Go)**

Assumptions:

Weight: 7oz/box = 0.198kg/box = 4.571 boxes/US ton

Cost: \$1.83/box + \$3.17 program operation costs = \$5/box

Reuse rate: 20 times usage before disposal

Volume: 80,000 to-go meals/semester, 4,000 G2Gs needed in one semester

Transport to landfill (Current method of disposal): 0.01018 metric tons CO<sub>2</sub> emitted from burning one gallon of diesel, 4.4 mpg average for a refuse truck, 70 miles to the landfill, \$75/ton paid to put one ton of refuse into the landfill

Transport to Recycling (Potential method of disposal): 0.01018 metric tons CO<sub>2</sub> emitted from burning one gallon of diesel, 4.4 mpg average for a refuse truck, 5 miles to the CCRRA, \$20/ton paid to recycle one ton

Social Cost of Carbon: \$42/metric ton CO<sub>2</sub>



GHG emissions: Value 1: 3.06 metric ton CO<sub>2</sub>-eq /US ton polypropylene plastic<sup>25</sup>  
 Value 2: 3,530 kg CO<sub>2</sub> emitted per 1000kg polypropylene<sup>26</sup>

		Value 1	Value 2
<b>Weight of one semester G2G</b>	4,000 G2Gs per semester / 4,571 G2G per US ton	0.88 US tons	793.79 kg
<b>Total emissions from semester</b>	0.88 tons * Value 1 OR Value 2	2.68 metric ton CO <sub>2</sub> -eq	2802.07 kg CO <sub>2</sub> -eq
<b>Semester Carbon Cost</b>	2.68 metric ton CO <sub>2</sub> -eq * \$42 per metric ton CO <sub>2</sub> -eq	\$12.47	\$117.69
<b>Average Social Cost/Semester</b>		\$115	

		Landfill	Recycle
<b>Social cost of CO<sub>2</sub></b>		\$115	\$115
<b>Cost G2G boxes to PSU</b>	4,000 G2Gs per semester *\$5 per box	\$20,000	\$20,000
<b>Cost of Disposal</b>	0.88 US tons * \$75/ton landfill OR \$20/ton recycle * (70 miles to landfill OR 5 miles to recycle * 4.4 mpg for refuse truck * 0.01018 metric tons CO <sub>2</sub> emitted from burning one gallon of diesel * \$42 social cost)	\$72.43	\$17.99
<b>Total Cost</b>		<b>\$20,188</b>	<b>\$20,133</b>

If the reuse rate for a G2G was 80 times before disposal:

		Landfill	Recycle
<b>Social cost of CO<sub>2</sub></b>		\$115	\$115
<b>Cost G2G boxes to PSU</b>	1,000 G2Gs per semester *\$5 per box	\$5,000	\$5,000
<b>Cost of Disposal</b>	0.22 US tons * \$75/ton landfill OR \$15/ton recycle * (70 miles to landfill OR 5 miles to recycle * 4.4 mpg for refuse truck * 0.01018 metric tons CO <sub>2</sub> emitted from burning one gallon of diesel * \$42 social cost)	\$23.21	\$4.86
<b>Total Cost</b>		<b>\$5,052</b>	<b>\$5,034</b>

G2Gs must be reused multiple times to match the environmental and monetary impact of single-use polystyrene to-go containers. However, the number that it must be reused varies based on which metric one looks at. To have a lower environmental footprint than the equivalent number of polystyrene containers, the G2G must be reused 20 times.<sup>27</sup> The G2G box costs 30.5 times more than a single-use polypropylene box.<sup>1</sup> Therefore, to account for just the price, the G2G must be reused 30.5 times. Finally, considering the costs needed to operate the entire G2G program, both the cost of buying the box and program operation costs, the G2G must be reused 80 times or more. These reuse rates are entirely possible, as the container is rated by the manufacturer to be able to be reused up to 1000 times. Reusing G2G containers reduces the amount of non-biodegradable polystyrene containers used and send to the landfill. As G2G usage rate increases above 20, the

<sup>1</sup> Data received from Purchasing

environmental footprint of creating the box decreases. As G2G usage rate increases above 31, Penn State Dining saves money due to not having to buy single-use polystyrene to-go boxes.

Converting to entirely using the reusable polypropylene Green2Go containers would be the best solution to mitigate carbon impacts of to-go containers.<sup>28</sup> This would require more education for students as well as an increase in student engagement in the program across the commonwealth. Biodegradable, compostable paper clamshells made of bagasse, as used in the HUB, are the best single-use alternative to expanded polystyrene. Bagasse is the fibrous waste product of sugarcane after the juice is extracted. Ordinarily, it would be used for biofuel, but it can also be turned into compostable materials as a sustainable alternative.<sup>29</sup> Bagasse clamshells are only about twice as expensive as polystyrene clamshells.<sup>1</sup> Using bagasse removes support to the oil and plastics industry and prevents styrene, a long-suspected carcinogen, to be leached into food. InnoPak, Penn State's current HUB dining supplier, provides bagasse clamshells.

However, the switch from polystyrene to bagasse to-go containers cannot be made right now. Currently, the polystyrene clamshells from to-go dining go to the landfill. If Penn State made the switch, then the bagasse to-go containers would go to the composting facility. The composting facility cannot currently process the additional volume of the lightweight bagasse clamshells it would receive. However, in the upcoming fall 2020 semester, the composting site will try to separate food waste and office compost, which may lead to decreased contamination and allow for more volume to be taken in.

Secondly, student waste stream education is crucial to the purity of the waste stream. The switch to bagasse compostables would have to be consistent across all the Dining service departments for students better understand which materials are compostable and which are not. Students require clear, consistent education as soon as a new waste item is introduced to understand how it should be properly disposed of into the waste stream. Student must understand the importance of separating items correctly to avoid stream contamination and "wish-cycling". Without proper student education, the boxes and the accompanying non-compostable items such as utensils, chip bags, condiment packets, etc. would end up in the wrong waste disposal stream.

## **Purchasing Analysis**

In Penn State's yearly consumption of pork and beef alone, the carbon footprint is over 2,552 metric tons of CO<sub>2</sub>-eq.<sup>2</sup> By reducing our beef and pork consumption by 20%, we can reduce our emissions by 510 metric tons of CO<sub>2</sub>-eq.

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<sup>2</sup> Based on a carbon footprint of 60 kg CO<sub>2</sub>-eq /kg beef produced and 7kg CO<sub>2</sub>-eq /kg pork produced<sup>34</sup>

## **Recommendations**

### 1. Conduct a Life Cycle Assessment of PSU Dining

PSU Dining's carbon footprint is not tracked in the overall inventory of Penn State GHG emissions. However, Dining still contributes to Penn State's carbon footprint: growing, transporting, preparing, serving, and disposing of food all produce carbon emissions. There is no comprehensive life cycle assessment available presently, so Penn State has no indication as to the size of the carbon impact of Dining, nor its scale when compared to the rest of Penn State's carbon emissions. A complete assessment should include the carbon impact of the food that is purchased by weight/volume, the transportation of the food from the source, the storage of the food, the preparation of the food, the utilities used in the kitchens and dining halls, the to-go containers and other service ware, and the disposal of the food and service ware. Only by calculating the actual footprint of Dining purchases, can we demonstrate what reduction in emissions could be achieved by using each the various strategies presented here.

### 2. Trayless Dining

*(Currently implemented by University of Michigan, University of North Carolina, Purdue University, and University of Minnesota)*

Trayless dining involves eliminating food trays in the all-you-care-to-eat sections of the dining halls. This has been shown to reduce post-consumer food waste, which made up 38% of dining hall food waste in the Fall 2019 semester at Penn State, resulting in about \$140,000 of food wasted. At Purdue University, it reduced post-consumer food waste by 18%.<sup>30</sup> At the University of Minnesota, it reduced food waste by almost 2oz. per person and reduced tray washing and sanitizing cost.<sup>31</sup>

When students do not have a tray to pile food on before sitting down to eat, they are more likely to just take the items that they want without taking extra food that will probably end up in the compost. This helps students with portion control and reduces food waste in the dining halls overall. Although trayless dining is being implemented this Fall semester due to social distancing restrictions, trayless dining should continue when in-person dining resumes.

### 3. Meat "less" Mondays

*(Currently implemented by University of Michigan and University of North Carolina)*

When students are given more vegetarian options, they tend to choose them at a higher rate. In a study from The University of Cambridge, when the cafeterias doubled the vegetarian meals available from 25% to 50%, vegetarian meal sales increased from 41% to 79%.<sup>19</sup> In order to create a culture shift in students, staff, and faculty alike who eat at the dining halls, "plant-based options must be available, visible, and enticing, including high-quality meat substitutes".<sup>9</sup>

Programs like a true Meatless Monday (serving only vegetarian options) have been piloted at commonwealth campuses such as Berks with feedback from students who say that they want meat-



based options at the dining hall all days of the week. However, this new Meat “less” Mondays program does not eliminate animal-based choices in the dining halls. Instead, plant-based options are highlighted, and there are more plant-based than meat-based entrees that day, to promote a more sustainable diet.

In conjunction with this program, the Dining Sustainability Team and Eco Reps could coordinate educational stations where students can learn more about the importance of plant-based eating. The Meat “less” Mondays program does not necessarily need to be run every Monday; even a once-a-month pop-up would create an impact in the minds of consumers and show that Dining is in touch with the way that the student population is trending. This program has a multitude of benefits including saving money, providing greater choice for diner satisfaction, stimulating culinary invention, demonstrating a commitment to health, and reducing environmental impact.<sup>32</sup>

There can also be small, market-based incentive at a la carte options for in-house plant-based options. In-house plant-based options are cheaper than meat-based options in terms of purchasing, even if a meat burrito and bean burrito cost the same to the customer at the check-out. Students can be incentivized to eat plant-based by availing this incentive, and in the long-term dining will save money.

#### 4. More plant-based signage (physical or digital)

When dining halls focus on sustainability, they can produce 2.5 times less carbon.<sup>33</sup> One of the ways to create an attitude shift towards plant-based eating is through signage. A student who regularly sees signs, such as in Figure 8, will be encouraged to try the plant-based entrée option. These signs can be posted physically on the walls of the dining halls, as digital signage in the dining hall, or as a flyer in the online ordering app. Further, giving explanations about the benefits of plant-based eating at the vegan/vegetarian entrée stations can help convince students to try plant-based dining as well.

Signage is also helpful to promote environmentally conscious habits such as composting and using Green2Gos. Signage should work in conjunction with in-person education from Eco Reps and/or the Dining Sustainability Team during pop-ups and pace-changers. This in-person education can provide education beyond what is written in the signage and clarify student questions.



Figure 8. Graphics created by Divya Jain as examples of plant-based signage. The “How to get 25 grams of protein with a lower carbon footprint than beef” sign is inspired by <https://br.pinterest.com/pin/414894184416099660/>

## 5. Increase the Dietary Completeness and Taste of Plant-based Entrees

There are some items on the 3-week menu cycle that are not dietarily complete enough to be considered entrees. For example, the vegetable turnovers<sup>3</sup> do not have sufficient protein content in a serving to constitute a balanced meal. Other times, there are recipes which may need to be improved, such as the chickpea meatballs which can be salty and dry. Sometimes there are international cuisine recipes that are not quite authentic, such as the vegetarian tofu tikka masala which uses tofu instead of paneer; this may decrease appeal of the vegetarian option.

The Vegan and Vegetarian Advisory Board at Penn State, in collaboration with a group of students who eat predominantly meat, should taste test vegan and vegetarian dishes both before the menu

<sup>3</sup> 294 calories and 5.8 grams of protein per serving

item is created, as currently done, *as well as* a few times through the semester as the meals are served in the dining hall. By formally evaluating the food on criteria such as taste, appearance, texture/mouthfeel, dietary completeness, and overall quality, this will improve the quality of the recipes in order to entice meat eaters to try a plant-based entrée and increase plants in their diets overall. This recommendation can be trialed in Spring 2021, social distancing restrictions permitting, by following up with Katy Petrosky, Corporate Registered Dietician, in October.

#### 6. Track Green2Go Boxes

Currently, Penn State Dining does not track individual Green2Go boxes. Thus, PSU Dining does not have accurate data on how often G2Gs are returned to the dining hall, how often students throw them out, or how many times they are reused before having to be disposed of due to wear and tear. Students have to manually keep track of their G2G token carabiner and free meal punch cards, but students and staff are sometimes liable to forget to exchange carabiners for a G2G or to get a punch. This means that students sometimes end up with extra or too few carabiners, leading to getting back too few \$5 deposits or extra \$5 deposits. Students may forget to get a punch in their free meal card, and thus not avail their incentives. All in all, the physical system is outdated and should be transitioned online.

Instead of using carabiner tokens and punch cards, Dining can track G2G boxes, tokens, and free meal punches digitally. This would simplify the program and make it more user-friendly, increasing participation rates. By adding barcodes to each G2G box, Dining can digitally track each box in the system as well as which student took this box. That way, Dining can make sure that the student returned the G2G. The digital system will track how many \$5 deposits the student has made so that there is no loss/gain on the dining or the student's part. Most importantly, Dining can gain accurate data on G2G usage rates to see if the boxes are being reused enough to outweigh the environmental impact of single-use to-go containers. This data will also aid Purchasing in buying the necessary number of Green2Gos for each semester. This is currently being developed with the Anna Sostarecz, Dining Sustainability Coordinator, and the IT team.

#### 7. Invest in Local Sourcing

*(Currently implemented by University of Illinois, University of Michigan, and the University of Minnesota)*

PSU is fortunate to be in a state and region where one of the main industries is agriculture. Because of this, we have many local and regional farms that supply both meat and dairy, as well as vegetable produce. If we can invest in our local communities, then we support the economy of our own state as well as reduce our carbon footprint by avoiding transporting foods over long distances. For example, expanding the acreage the Student Farm will allow the farm to grow a greater volume of produce and thus supply dining with hyperlocal organic produce. PSU Dining should especially consider the amount of food, such as produce and meat, that is purchased from international sources. To minimize the carbon footprint of food transportation overseas, Dining should be stringent on not purchasing internationally.

Currently, 16-18% of our produce is sourced from PA manufacturers and farmers. We can increase this amount more, however. We can do this by creating incentives within the supplier bidding process. If there is a product from a local supplier that meets university standards and passes the



executive chef taste testing process, then it should be given a PA premium in the competitive bidding process.

#### 8. Standardize Sustainability Initiatives Across all the Commonwealth Campuses

We are Penn State, so let's be Penn State strong in sustainability across every campus. Some campuses have more sustainability initiatives than others. We can standardize some of the common initiatives and then allow campuses to innovate ideas that work for their campus, and eventually extend to the other commonwealth campuses as well. Commonwealth campuses should have representation at UP menu-planning and other sustainability planning meetings. If there are sustainability initiatives implemented at UP, they should be piloted at Commonwealth campuses, and vice versa. Examples include Brandywine's Food Advisory Board feedback wall and Behrend's herb garden.

#### 9. Reducing Food Insecurity by creating a "Community Drop Point"

Food insecurity affects about 30% of college students. We can see that there are places near campus that tackle this issue such as Abba Java café downtown and the Lion's Pantry. Extending these efforts to on campus will continue to provide food to students who need it and reduce the food waste of on-campus events.

When there is food left over from events such as club meeting or luncheons on campus, people could bring that food to the Community Drop Point in the Knowledge Commons of the library, a commonly visited central building on campus. The food collected at the drop point would be open to any student who wishes to take it. At the drop point, there would be volunteers who make sure that the food is cleaned up at the end of the day. There would also be educational signage from the Lion's Pantry about food waste, food insecurity, and why they are important to tackle. This recommendation can be trialed in Spring 2021, social distancing restrictions permitting, by following up with Ann Thompson, Knowledge Commons Manager; Joe Fennewald, Head of the Knowledge Commons; and Spencer Wallace, Lion's Pantry President in October 2020.

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