RUTGERS
Office of the President
TASK FORCE ON CARBON NEUTRALITY
AND CLIMATE RESILIENCE

Solutions Assessment: Food and Water Systems

Report of Working Group 3

January 2021

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EXECUTIVE SUMMARY

Climate solutions associated with food will need to come from a number of different areas within the food system. Globally, approximately 26% of greenhouse gas emissions (GHGs) are associated with food production with 8% of global total coming from food waste. GHG emissions associated with food come many resources: food production methods that consume energy, water, soil and land area; packaging; food decomposition (especially in landfills), to the chemical used in refrigeration. It will take a lot of different people working together toward a more sustainable and climate-friendly food system to bring about climate solutions for the food system. Food justice, food security, and food equity[1] are also factors that must be considered when implementing change.

Reducing food GHG emissions is a major focus for campus food service companies as well as for the food service industry in general[2,3,4]. While Rutgers Dining Services, which serves over 6 million meals per year, has been working on sustainability issues for a long time, focusing on GHG emissions is relatively new.

WG3 estimates that Rutgers Dining Services contributes only a small part of Rutgers' overall GHG emissions (about 20,000 tonnes in FY19, about 7% of overall emissions quantified). WG3 has discovered through data collected from Rutgers Dining Services and calculated using SIMAP® that **the greatest contributors to food-related GHG emissions are the consumption of beef (37%) and chicken (28%) in the dining halls.** Some of our GHG emissions are still unknown, especially with respect to beverages, vending machines as well as dining at Newark and Camden which is managed by Gourmet Dining, LLC. We have not estimated off-campus GHG produced by our students.

Food waste also contributes to our GHG emissions. Some preliminary calculations have been made and show that more can be done to reduce food waste and to capture the food waste we generate. We have not attempted to estimate food waste created by other campus food service groups nor estimated the contributions of off-campus households to food waste related GHG emissions. Future food waste reduction initiatives support by Rutgers will also support the USDA, EPA[5] and State of New Jersey's new food waste reduction plan[6] to achieve a 50% reduction in food waste by 2030. This reduction will help to curtail methane production in landfills and reduce waste throughout the system.

There is much more that can be done to further reduce Rutgers food systems' impact on climate change. WG3 has identified solutions to reduce campus-based GHG emissions, and in some cases off-campus GHG emissions, and recommend that these be considered as part of the climate action plan. These solutions/interventions including:

1. **Shift to a more "Plant Forward" (Plant Rich) Diet**
    a. Evaluate and change recipes and menus to achieve target of 25% reduction in GHGs by 2030 from 2019 baseline (see Fig. 3.3).
    b. Lead with taste
    c. Leverage Menus of Change University Research Collaborative (MCURC)

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[1] For more about food justice, food security, and food equity, see: https://foodprint.org/issues/food-justice/ and this video "Food for Thought: The Path to Food Security in Newark" (https://youtu.be/hZLgLFOAcrs). Also note that many of our students work in the food system, both on- and off-campus, so these issues impact them directly.
[2] Menus of Change University Research Collaborative (MCURC), https://www.moccollaborative.org/
[3] Environmental Game Changers, Compass Group: https://www.compass-group.com/en/sustainability/our-pillars/environmental-reporting.html
[4] World Resources Institute "The Cool Food Pledge" https://www.wri.org/our-work/project/cool-food-pledge
[5] United States Food Loss and Waste 2030 Champions: https://www.epa.gov/sustainable-management-food/united-states-food-loss-and-waste-2030-champions
[6] State of New Jersey, Department of Environmental Protection, Food Waste Plan. https://www.nj.gov/dep/dshw/food-waste/ and https://www.nj.gov/dep/dshw/food-waste/food_waste_reduction_plan.html

   d. Co-benefits: health, environmental health, landscapes
2. **Climate-friendly food labeling**
3. **Adopt a climate-friendly food labeling system for online menus**
4. **Consumer Education and Awareness Campaigns**
   a. On campus: for students on meal plans
   b. Off-campus: for students, faculty, staff and alumni
5. **Reduce Food Waste**
   a. Targets to be established to reduce food waste
   b. Explore with the local communities the need for anaerobic digestor and/or commercial composting
6. **Reduce single use plastic (post-COVID)**
   a. Replace single use plastic bags with reusable bags
7. **Reduction of consumable goods especially those associated with food takeout/convenience or catering**
8. **Increase use of re-useable water bottles and hydration stations**
   a. Tap water has 1/300th to 1/1000th carbon footprint compared to a single use plastic bottle of water
9. **Continue supporting locally sourced fresh products when in season**
10. **Enhance outreach and explore incentives for better farming systems, food production systems, delivery methods, and sustainable products.**
11. **Highlight climate friendly refrigeration management**
12. **Upgrade snack and beverage vending machines to Energy Star Ratings.**

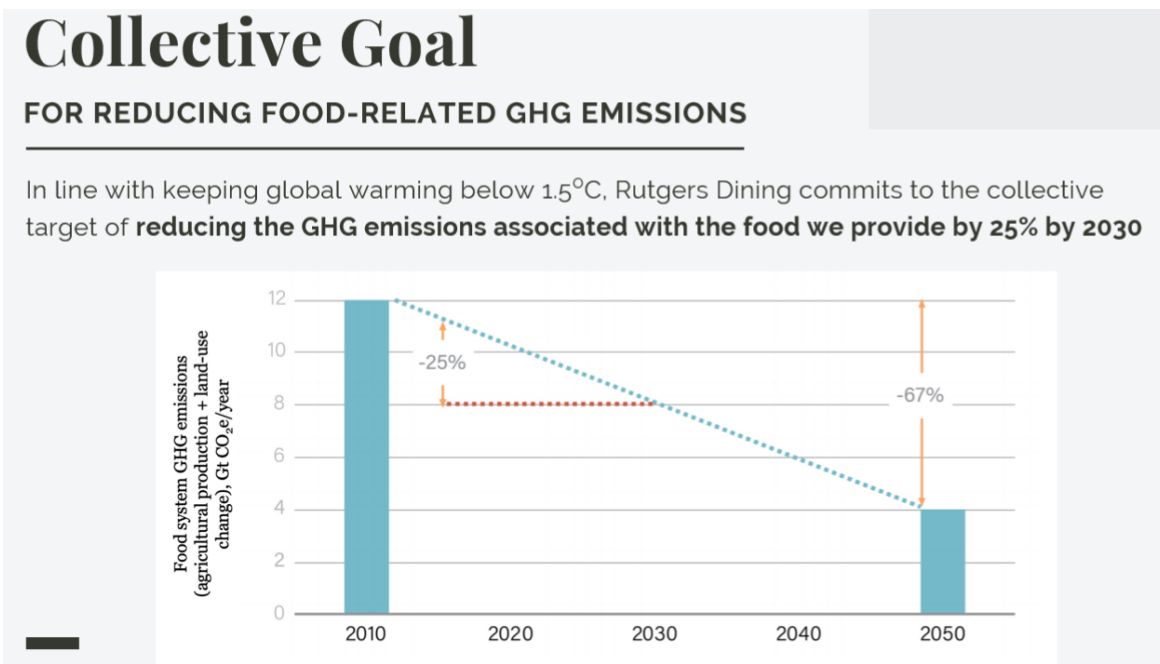

Figure. 3.1. Rutgers Dining Services GHG emissions reductions targets

Some of these solutions could be implemented in 2021-2023. WG3 estimates that investments and changes to our food system, diets, and food waste habits will be able to reduce GHG emissions from food by at least 20% over the next 10 years, with further gains possible depending on the types of changes implemented. This number includes a 2019 commitment as part of Menus of Change University Research Collaboration (MCURC) to a 25% reduction in protein associated GHG emissions by 2030 (Fig. 3.1). In implementing any recommendations, food justice, food security, and food equity issues should be considered throughout the supply chain.

WG3 also considered some other solutions such as purchasing of imperfect delicious produce, but Rutgers Dining has already tried this and found it to be difficult to implement since it needs to define the specifications for bidding for our food purchases. Revisiting this solution is still an option.

Additional recommendations are made in conjunction with WG4 for food waste initiatives. Additionally, this section does not consider GHG sequestration by the land used to produce the food consumed.

What follows are more details of Working Group 3's (WG3) efforts to catalog GHG emissions associated with Rutgers Food System Scope 3 emissions and other sustainability efforts as well as possible solutions aimed at creating targets for GHG emissions reductions from food and water systems. Some of this information is also available in the Appendix.

3.1. Rutgers' current baseline

3.1.1. Rutgers' greenhouse gas emissions in Food and Water Sector

Estimates for Rutgers the baseline for Scope 3 greenhouse gas emissions for the Food and Water Sector have been challenging to collect across all campuses. Below is a summary of information that has been gathered so far and includes estimates from Rutgers Dining (New Brunswick). WG3 did not collected food data from the other food service on the New Brunswick campus which includes Currito's, Gerlanda's, King Pita, Panera, Subway, Wendy's, Moe's, Szechwan Ichiban, Hoja, Qdoba,16 Handles, Gourmet Dining, Hillel or Chabad House.

Further work and information are needed to complete the baseline using data from our vendor, Gourmet Dining, LLC, in Newark and Camden.

Based on SIMAP analysis, Rutgers Dining's FY19 food-related emissions totaled 20,462 tonnes CO_2e, roughly 3.3 kg CO_2e per meal served. The breakdown of these emissions is shown in Figure 3.2. The largest share is due to beef (37%) and chicken (28%), though these two food sources constitutes only 4% and 15% of the overall weight of food purchased, respectively. Plant-based foods (vegetables, grains, fruits, etc.) constitute only 15% of overall emissions, though they constitute 62% of the weight of food consumed.

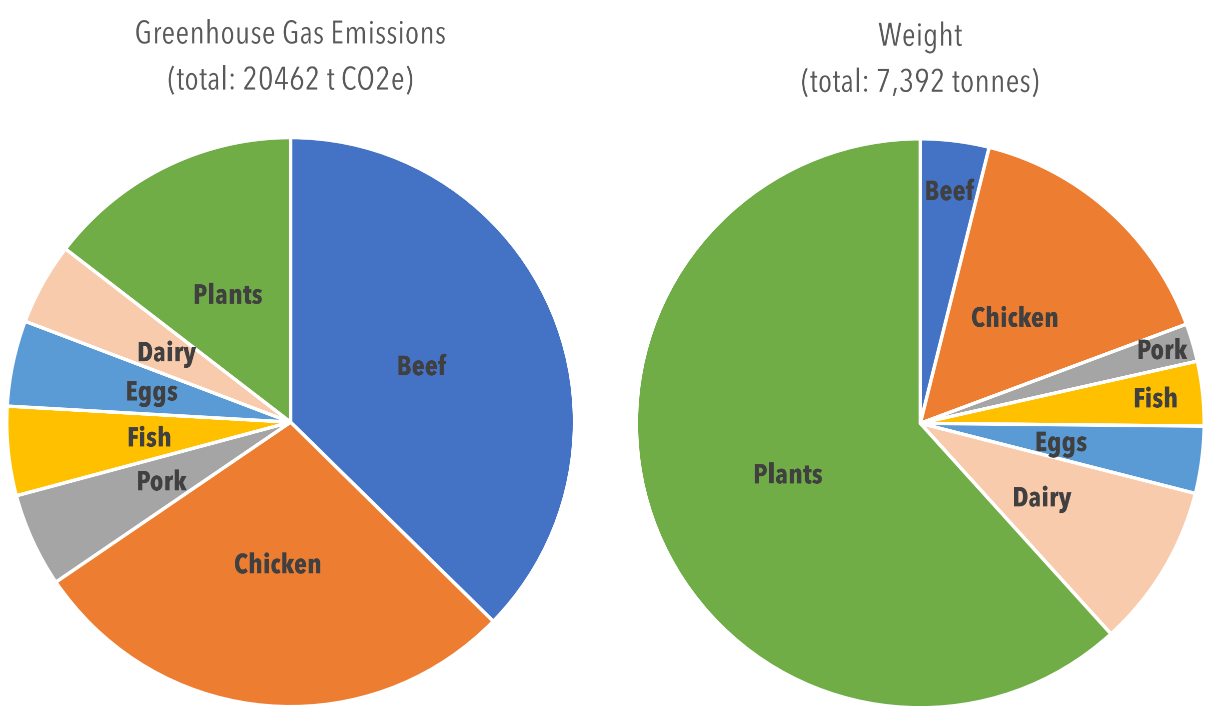

Figure. 3.2. Emissions (left) and total weight (right) associated with food purchased by Rutgers Dining Services in FY2019, based on SIMAP analysis

3.1.1.1 Rutgers Food Systems and Sustainability

An overview of Rutgers Food Systems, from dining to food sourcing and production, was outlined in our July Interim report in Section 11.3 and readers are asked to refer to this report for background[7]. In

[7] https://climatetaskforce.rutgers.edu/wp-content/uploads/sites/332/2020/07/2020-07-17-Interim-Report-FINAL.pdf

summary, 6,267,201 million meals were sources, prepared and served by 1742 staff and 802 students of Rutgers Dining in FY19, our baseline year. These numbers are significantly lower during FY20 and this year due to the pandemic.

Rutgers Dining Services is a leader around the country when it comes to campus dining sustainability efforts. Examples of sustainability efforts that help to reduce GHGs are already in place or underway and some of these efforts are summarized in Table 3.1 and Fig 3.2. This list shows significant and sustained effort by Rutgers Dining Services to reduce the environmental impact of food service on campus and which have already reduced the GHG baseline for Rutgers Dining Services. Local foods make up 81% of the food purchased. Also notable are the co-benefits of sourcing food locally: preserving farmland and green spaces in New Jersey, Pennsylvania, and New York, supporting the local economy, and building local communities. This list of practices means that Rutgers Dining Services baseline for GHG emissions (FY2019) is relatively low compared to other schools who have not implemented these practices.

Table 3.1. Examples of Food-related emissions reduction activities at Rutgers Dining Services in New Brunswick (NB) (Source: http://food.rutgers.edu/sustainability/ and presentation "2020 Rutgers Dining Services Sustainability Practices, Sustainable Food Service" a Rutgers Dining presentation on this website.)

- New menu choices, e.g. blended burger
- Sustainable Food Sourcing and Purchasing
    - 81% local food purchases (<250 miles)
    - By-catch seafood purchases
- Food purchasing inventory control
- Tracking Food-Related GHG Emissions
- Food donations to Rutgers Student Food Pantry (NB) and local food insecurity partners
- Food waste from Busch Dining Hall feeds pigs
- Trayless dining (2014): 22% reduction in food waste
- Reusable Bag + Bottle Program (Meal Plans)
    - Over 1,500,000 cups, straws and lids have been saved from the landfill
    - 300,000 bags saved from going to the landfill
- Vegawatt Generator
    - waste cooking oil is converted to electricity and heat (hot water for cleaning dishes)
- Food Waste Digesters at Neilson Dining Hall, Busch Dining Hall, Henry's Diner and Harvest Cafe
    - waste food trimmings and leftover food broken down by microorganisms and converted into environmentally friendly "wastewater" and discarded to sewer system; reduces need to take waste to landfill
- Packaging Reduction and Recycling
- Pilot for food waste and student education campaign
- Sustainability within operations including:
    - energy and water efficiencies
    - box recycling
    - LED Light Bulbs (>80% energy savings)
    - Better refrigeration design in new facilities

Figure 3.3. Rutgers Dining Services sourcing and purchasing baseline (FY2019)

Figure 3.4. Benefits from buying local

WG3 also obtained a list of sustainability efforts by Gourmet Dining, LLC., the food vendor for our Newark and Camden Campuses as well as Athletics food operations (Table 3.2). These sustainability efforts are very similar to sustainability efforts by Rutgers Dining. Gourmet Dining has made recent advances with single plastic bag elimination and "STOP FOOD WASTE DAY". Gourmet Dining also has tracks food waste using the Trim Trax ™ program[8], developed by Compass Group USA, Inc. (Gourmet dining's parent group), which has can be used for GHG emissions reductions. Compass Group USA has committed to reducing food waste by 25% by 2020 from its 2016 baseline[9]. "Stop Food Waste Day" is part of Earth Month and is used to promote food waste awareness and reduction. A new Carbon Foodprint program from Compass group will be implemented by Gourmet Dining when they begin operations[10].

Table 3.2. Sustainability measures from Gourmet Dining, LLC (Source: Brain Conway, Dining Director, Rutgers Newark)

The Rutgers Newark Dining Program has always been driven to become an efficient, sustainable and vital component of our Rutgers Newark community. Included below are only some of the sustainable practices we execute on a daily basis. • We are trayless dining – water reduction, reduces food waste • Plastic Bag free - We have removed all plastic bags from our campus • Weekly Food Donations to campus and surrounding pantries • Recycling of all used cooking oil • All our to-go containers are reusable and recyclable • Plastic utensils are made from fully recyclable products • Dish Washer is energy efficient • Trim Trax Program – Utilized in our kitchens to monitor food waste from yield. All food donated to composting initiatives • Compass Group WASTE NOT program - to track, measure and reduce food waste at the unit level to save on hauling costs, production costs and food waste. • Imperfectly Delicious Produce – rescued produce which helps reduce the emissions of methane gas that is produced from decomposing produce • Save the Food – Root to Stem cooking training • STOP FOOD WASTE DAY – we weigh all wasted food in our dining program so our guests can see a tangible fact on the amount of food that is actually wasted daily • We buy from local farmers – Here in Newark we utilize the COMMON MARKET – a contingency of 12 NEWARK based farms and farmers • Shared composting program with NJIT, a sister university across the street • We have water dispensers in our dining areas for our staff, reducing the amount of single use bottles used • We give special consideration to Newark residents when we hire for a position These are some of the items the team at Rutgers Newark utilizes in our fight for sustainable practices and against Climate change.

3.1.1.2 Rutgers Drinking Water

For the first time, this working group has gathered background information on drinking water and explored the impact that single use plastic bottles has on Rutgers GHG emissions. Upon hearing concerns over the quality of water at our earlier townhall meetings, we explored Rutgers drinking water systems from public water utilities (see Appendix), Rutgers hydration systems and water bottle usage. Data has been collected

[8] TrimTrax trademark: https://trademarks.justia.com/774/48/trim-77448236.html

[9] https://www.compass-usa.com/compass-group-usa-announces-landmark-commitment-reduce-food-waste-25-2020/

[10] Personal communication from Brian Conway and Julia Jordan to Xenia Morin, 11/11/2020. The Carbon Foodprint Tool in an online tool that can be used by managers to help track the environmental impact of food service. This tool may be licensed with a monthly fee of $85 per cost center.

from Rutgers through the climate task force survey, and some of its vendors. Currently more work is needed to create a baseline number but estimates can be made for GHG emission savings from shifting from single use water bottles to reusable water bottles with filtered tap water.

Outside of Rutgers Dining Services, spending of bottled water by Rutgers departments was $287,584 (FY20; July – May) and $387,273 (FY19). This water was provided by 4 and 5 vendors, respectively[11]. Other beverages were purchased as part of a ColaCola pouring contract. Spending in FY19 totaled $1,428,500[12]. WG3 does not yet know how many bottles or what volume of water these dollar amounts represent nor how many offices are currently supplied but offices that have switched to filtered water systems report cost savings at the departmental level. Whether there is the possibility to increase the amount of office-based water filter systems is unknown at this time.

3.1.1.3 Vending Machines and Hydration Stations Maps

Based on data obtained from Rutgers procurement, additional maps of Rutgers food systems were created. Newark's campus is home to 24 snack vending machines, with only 2 having Energy Star Ratings, while Camden's campus has only 10 snack vending Machines. On the New Brunswick Campus we find the following numbers of snack vending machines: Busch Campus: 42; Livingston: 20; College Ave: 32; and Douglas/Cook Campus: 25. Many have LED lighting, which reduces energy use, and Busch Campus has the highest number of Energy Star rated vending machines with 19 (45% of total).

We have produced Google map layers which include the locations of snack vending machines and hydration stations (see Appendix C) and these will be posted publicly at a later time on the sustainability website. These maps also include information about their sustainability features, such as LED lighting and energy star ratings, where available[13]. Maps for beverage vending machines at the New Brunswick campus have also been made but are not shown here. There are some vending machines at other non-campus locations and those have also been cataloged. We believe that upgrading to energy star vending machine could reduce GHG emissions but this may have a small impact overall.

3.1.1.4 Food and Catering Spending

WG3 has also obtained data from Rutgers Procurement Office[14] for food and catering spending at RU-New Brunswick, RU-Newark, RBHS, intercollegiate athletics, RU-Camden and other university units. Total spending was $10,124,239 in FY19, with approximately 11% ($1,150,420) to Gourmet Dining Services, LLC. WG3 has not calculated GHGs emissions associate with catering services.

3.1.1.5 Background on Indirect Emissions

Emissions from food systems, from production through supply chain and food waste, are categorized as Scope 3 emissions. Scope 3 emissions refer to all indirect emissions created by Rutgers that are associated with agriculture and food. Some Scope 1, such as fleet transportation for Rutgers dining, energy used for cooking on campus, and energy used for cold storage for food, are associated with Rutgers food systems on campus but were not quantified by WG3 for this report. While fleet transportation is known and could be shifted to electrification or other renewable energy sources, no data is available for the amount of energy used for cooking and cooling by facility because we do not have meters recording this data.

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[11] Data provided by Rutgers Procurement.
[12] Data provided by Rutgers Procurement.
[13] These maps will be posted at a later date on the Rutgers sustainability website.
[14] Dennis Demarino to Xenia Morin, personal communication, 7/1/2020.

According to the Corporate Value Chain (Scope 3) Accounting and Reporting Standard of the GHG Protocol, Scope 3 is comprised of 15 categories[15]. For the purposes of the Food Systems and Water working group the 2 most important categories considered were:

Category 1: Purchased goods and services (which includes food and water)
Category 5: Waste generated in operations

Scope 3 accounting presents enormous methodological challenges. There are two major barriers to accurate quantification of Scope 3 emissions: first is data availability, and second is boundary-setting. Data was available from Rutgers Dining Services and this has been used for this report. Additional data is still being tracked down and, if sufficiently robust enough for GHG calculations, will be integrated into the climate action plan proposal once available.

From a methodological perspective, there are significant differences in the GHG emissions associated different foods and with different with food production methods[16], and to standardize calculations and allow for comparison with other schools, the SIMAP carbon and nitrogen-accounting platform[17] was used to calculate GHG emissions from food sourced by Rutgers Dining. SIMAP requires that we be able to provide information on the food product, the weight or volume of purchase, whether the food was local (<250 miles) and/or certified organic. One challenge in calculating GHG emissions is that food purchases may change with the seasons, so some estimates have been made to reflect net purchases over 2018-2019 (FY2019).

GHG emissions are also associated with refrigeration and the cold supply chain[18]. These emissions are associated with the energy used for cooling and maintenance of cold or freezing temperatures, as well as emissions associated with the inadvertent release of refrigerant compounds. According to Project Drawdown, older refrigerants, CFCs and HCFCs, which caused ozone depletion were replaced by HFCs under the Montreal Protocol. HFCS spare the ozone layer but have very high global warming potential (GWP) compared to CO_2 (1,000-9,000 times) and must be handled carefully to prevent release. An amendment to the Montreal Protocol was negotiated in 2016 with phase outs in the U.S. beginning in 2019. Substitutes are now on the market. Great care must be taken at the end of the refrigeration equipment's life to ensure that these chemicals are not released but instead reused or transformed into compounds that no longer cause warming[19]. NJ DEP and EPA oversee refrigerant handling. WG3 has not performed an audit of refrigerant containing items on campus but anticipates these units are abundant in research laboratories, offices, food service locations and residence halls. Not all of these locations are for food, but nonetheless, waste disposal of any refrigeration units should be done under supervision according to regulations[20]. Rutgers has started to design new dining facilities with a glycol loop which cools equipment without contributing heat to the indoor space which reduces the need for additional air conditioning and lowers GHG emissions. This approach demonstrates that refrigeration practices can be designed into future dining facilities.

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[15] Corporate Value Chain (Scope 3) Standard. http://www.ghgprotocol.org/standards/scope-3-standard. New protocols for carbon removals and land use were issued on 10/15/2020 and were not used for this report.
[16] Poore and Nemecek (2018) Reducing food's environmental impact through producers and consumers. *Science* Vol. 360 (6392), pp. 987-992. DOI: 10.1126/science.aaq0216. https://science.sciencemag.org/content/360/6392/987
[17] SIMAP® Homepage: https://unhsimap.org/home
[18] Hu et al (2019). Potentials of GHG emission reductions from cold chain systems: Case studies of China and the United States. J. Cleaner Production. Vol. 239, 1. https://doi.org/10.1016/j.jclepro.2019.118053 https://www.sciencedirect.com/science/article/abs/pii/S0959652619329233?via%3Dihub
[19] Project Drawdown, Refrigerant Management. https://drawdown.org/solutions/refrigerant-management
[20] https://www.epa.gov/section608/revised-section-608-refrigerant-management-regulations

3.1.1.6 Rutgers Dining Carbon Food Footprint

Working Group 3 has obtained data for food purchased for FY2019 for food used in Rutgers Dining operations on the New Brunswick campus to estimate its scope 3 emissions. Data analysis has allowed us to identify and estimate key GHG contributions using SIMAP, a GHG calculator. Over 33,000 meals per day during the semester, and over 6,267,210 meals were served in FY2019 by Rutgers Dining. Based on SIMAP analysis, Rutgers Dining's FY19 food-related emissions totaled 20,462 tonnes CO_2e, or roughly 3.3 kg CO_2e per meal served. A summary of the SIMAP data is shown in Figure 3.2 and Table 3.3. Beef (37%) and chicken consumption (28%)[21] make up 68% of our estimated GHGs related to food purchases and are the largest contributors overall. Pork, fish, egg and dairy each made up 5% of emissions, while plant-based foods constituted the remaining 15%. While emissions associated with chicken purchases has lower GHG emissions per unit weight than beef, much more chicken is consumed in Rutgers Dining Facilities which increased its overall net emissions.

Table 3.3. Emissions and total purchases by Rutgers Dining Services, FY 2019, based on SIMAP analysis.

Category	GHG (t CO_2e)	Weight (tonnes)
Beef	7641	289
Chicken	5760	1141
Pork	1093	159
Fish	1036	271
Eggs	998	282
Dairy	951	688
Plants	2982	4562
Total	**20462**	**7391**

Some additional data on sustainability measures has been collected from Gourmet Dining, LLC, the Rutgers food vendor at the Newark, New Brunswick, and Athletics. This group adheres to many sustainability initiatives and these are summarized in Table 3.2, above. Additional data is still needed from this group to calculate GHG emission associated with food sales as this data is collected by its parent company, Compass Group.

See the Working Group on Supply Chain and Waste Management report for detailed information on food waste at GHGs at Rutgers.

3.1.1.7 Food Waste Reduction

Food: Source reduction initiatives are at the forefront of waste reduction strategies in Higher Education institutions. In fact, Rutgers University's peer institutions have developed robust and model source reduction programs. A number of institutions have implemented reusable to-go containers with the complete removal of disposable containers. In addition to source reduction strategies, Syracuse, Duke, Cornell, University of Pennsylvania and University of Maryland have focused on increasing the composting of organic waste. Composting organic waste helps divert organics from landfills and incinerators, ultimately reducing their impact procurement, the idea is to bolster and increase local and regional purchases as much as feasibly possible. In order to support local purchasing, peer institutions have implemented on-campus farms and gardens.

[21] This may be an overestimate as the Chicken comes from Bell & Evans in Pennsylvania (local) which are grown with organic feed and high animal welfare standards and are processed in a modern facility (https://www.bellandevans.com/our-farms/).

Most importantly, the education of the community of students, faculty and staff around sustainable dining has and will play an important role here Rutgers as it has at our peer institutions. For example, programs such as Cornell's "Beyond Ramen" food literacy program and the establishment of the "Water and Food Security Lab" at MIT are breeding grounds for sustainability innovation, engagement and progress. Education about sustainable dining presents a key opportunity for enhancing sustainable practices, driving successful outcomes and ultimately sensitizing the community.

Food waste diversion calculations for Rutgers New Brunswick have been done in conjunction with Working Group 4. These calculations show that diversion of food waste to centralized anaerobic digestion facilities, and commercial composting facilities, could contribute to GHG emissions reductions. Anaerobic digestions at a commercial scale has the added benefit of reducing methane emissions from landfills. There are also smaller scale operations such as the Rocket Composter that might be suitable for some campus locations[22].

3.1.1.8 Off-Campus Food

This working group has not estimated the GHGs emission associated with off-campus food and water consumption by students, faculty and staff. We have set this as a boundary for our Scope 3 calculations. However, while we will not be able to easily measure impact, WG3 believes there are opportunities to educate our communities to reduce food waste which can also result in GHG emissions reductions and cost savings for individuals and families. Food waste education reduction requires an understanding of the Food Recovery Hierarchy[23] and other tools already developed by the EPA "Food Too Good To Waste."

3.1.1.9 Water Systems

This report extends beyond food to include an evaluation of our drinking water systems since reduction in the use of single use water bottles provides an opportunity for GHG reductions. GHG emissions associated with single use water bottles come from the fossil fuels used to create the plastic bottle as well as the cold storage and transportation in the supply chain.

A summary of the drinking water public utilities is available in Appendix B.

3.1.2. Rutgers' climate vulnerabilities in Food and Water Systems

Rutgers food and water systems have multiple climate systems vulnerabilities. These come from a wide range of potential disruptions in the supply chains that serve the Rutgers campuses. Weather related events such as droughts, heat waves, hurricanes and floods can impact both off-campus and on-campus food systems. Off-campus food systems workers are also vulnerable to climate change, especially when there is excessive heat during harvesting. Weather disruptions to our transportation systems also make it hard for Rutgers Dining Staff to travel to food service facilities. Please refer to the Working Group 6 report for more details.

3.1.3. Ongoing activities to reduce emissions and vulnerabilities

3.1.3.1 Ongoing reductions activities

Rutgers Dining and Gourmet Dining have a strong commitment to sustainability. Rutgers Dining has been sending food waste to a pig farmer for over 100 years and has received many awards for their sustainability initiatives (see: http://food.rutgers.edu/sustainability/ and presentation therein for more details, also Table

[22] See: https://foodwastexperts.com/rocket-composter

[23] Sustainable Management of Food, Food Recovery Hierarchy, U.S. Environmental Protection Agency (EPA). https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy

3.2). Many of these sustainability efforts have also resulted in GHG emissions reductions, although the extent of these reductions has not been quantified in most cases. Rutgers dining takes a "Feed People, Not Landfills" approach which targets reduction of food waste going to landfills

For example, Rutgers Dining's Reusable bag and bottle programs have been integrated into their takeout operations. Rutgers Dining no longer provides plastic bags or paper cups at takeout, every student with a meal plan receives a reusable bag and bottle courtesy of Rutgers Dining. Rutgers reusable bag + bottle program, pre-COVID, was intended to eliminate the use of plastic bags, Styrofoam cups, paper waxed cups, lids and straws. Over 1.5 million cups, straws and lids have been saved from going into landfills to date. By switching to reusable bags, on average 300,000 plastic bags per semester are saved from going to landfills. Under COVID-19, takeout has had to adapt for food safety reasons and disposables are currently used. Reusable bags and bottles will be reintroduced once food safety measures allow.

Rutgers Dining is a member of the Menus of Change Research University Research Collaborative (MCURC). In 2019, MCURC members have committed to GHG emission reductions and Rutgers Dining has specifically committed to a 25% reduction in food-related greenhouse gas emissions by 2030 (Fig. 3.5). Calculations performed for MCURC estimate Scope 3 food-associated GHG emissions 115.3 million pounds of CO_2e in FY2018 and 127.9 million pounds of CO_2e in FY2019.

Shared Target for Food-Related Greenhouse Gas Reductions:
In fall of 2019 MCURC set the collective target of a 25% reduction in food-related greenhouse gas emissions from protein portfolio purchases by 2030, aggregated across all participating MCURC institutions. This reduction will be driven by changes over time in the ratios of the various protein sources in the collective protein portfolio, aligning with the following MOC principles:

- Make Whole, Intact Grains the New Norm
- Move Legumes and Nuts to Center of the Plate
- Serve More Kinds of Seafood More Often
- Use Poultry and Eggs in Moderation
- Serve Less Red Meat, Less Often
- Reimagine Dairy in a Supporting Role

We are thrilled by the tremendous enthusiasm and support this initiative has received, and want to express our gratitude for **Rutgers University's** continued participation. In 2019 this initiative aggregated over 100 million pounds of food purchases, representing 26 member institutions! This resource provides analysis of **Rutgers University's** food purchases across the protein portfolio for 2019 as compared to protein portfolio purchases in 2018 (see back). Data is included for both pounds of foods purchased and food-related greenhouse gas emissions across the protein portfolio.

Rutgers 2018-2019 Comparison: Total GHG Emissions

University Total food-related GHG emissions (2018)	University Total food-related GHG emissions (2019)
100% = 115.3 million pounds CO_2e	100% = 127.9 million pounds CO_2e

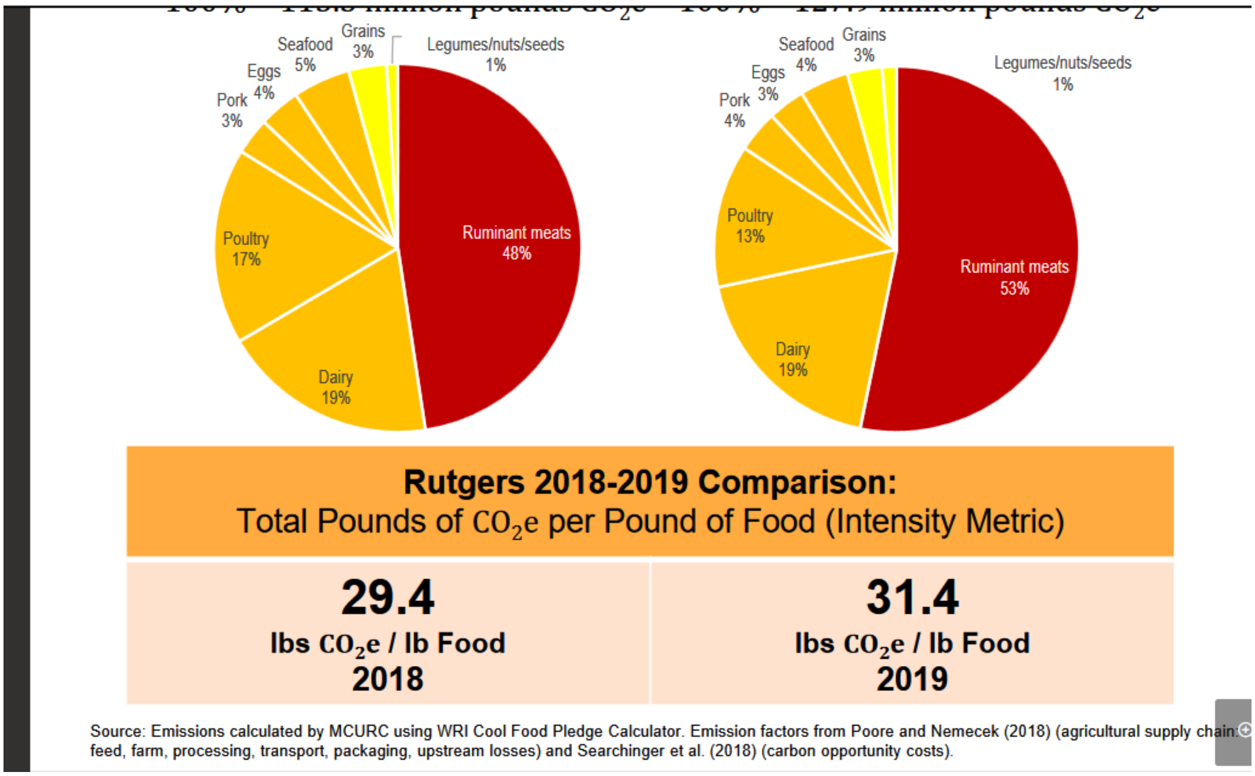

Figure 3.5 MCURC Data reported for 2018 and 2019 This data was calculated using the Cool Food Pledge calculator rather than SIMAP.

3.1.4. Related ongoing educational, research, and service activities

3.1.4.1 Education

Education focusing on food, agriculture, aquaculture, food production, and food systems can be found in both formal and informal educational settings, from traditional classrooms, labs and greenhouses and daycare/pre-school centers on campus such as the Institute for Food, Nutrition, and Health (IFNH) Center for Childhood Nutrition[24], to our extension services and activities at including greenhouses, horticultural farms, student farms at Rutgers Gardens. Education also happens at campus dining halls, residence halls, student food pantries and health services. Rutgers Healthy Dining Team (http://food.rutgers.edu/aboutus/healthydining/) plays an important role in informal education about nutrition via student peer-to-peer outreach in the dining halls under the supervision of Dr. Peggy Policastro. Gourmet Dining also participates in informal dining education in the facilities it operates.

Undergraduate education at Rutgers which focuses on food, agriculture and water, is very interdisciplinary and can be found to different degrees across campuses and school. Undergraduate Degrees and courses can be found in many programs and is summarized in Table 3.4[25]. Interestingly, at least 50 different programs and departments across all three campuses offer courses that touch on these subject areas.

Table 3.4. Undergraduate Education At Rutgers University (NB, NK, CD). Programs or Department by name in alphabetical order or program code order (School code: Program code) which offer courses with content in food, agriculture or water.

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[24] IFNH Center for Childhood Nutrition: https://ifnh.rutgers.edu/centers/childhood-nutrition-education/

[25] Complied from courses listed in the schedule of classes for Spring and Fall 2019. This list may be incomplete.

Source: Rutgers Schedule of Classes, 2019 and 2020. (https://sis.rutgers.edu/soc/) and Degree Navigator Advisor (dnadvisor.rutgers.edu)

1) Byrne Seminars (01:090; 11:090)
2) FIGS Seminars (01:090; 11:090)
3) Honors Seminars (01:090; 11:554; 55:535; 21:525)
4) Africana Studies (01:014)
5) Agriculture and Food Systems (11:020)
6) Agriculture and Natural Resource Management (11:035)
7) American Studies (01:050)
8) Animal Science (11:067)
9) Anthropology (01:070; 50:070; 21:070)
10) Civil and Environmental Engineering (14:180)
11) Chemistry (01:160)
12) Community Health Outreach (11:193)
13) Classics (11:190)
14) Ecology (11:216; 50:120; 28:120)
15) English: Writing Seminars(01:355)
16) English: Creative Writing (01:351)
17) Entomology (11:370)
18) Environmental Business Economic (11:373)
19) Environmental Policies, Institutions and Behaviors (EPIB)(11:374)
20) Environmental Sciences (11:375; 28:375)
21) Environmental Studies (01:381)
22) Food Science (11:400)
23) French (01:420)
24) Geography (01:450)
25) Geological Sciences (01:460; 21:460)
26) Global Studies (55:480)
27) History (01:506; 50:510; 21:510; 28:510)
28) Italian (01:560)
29) Landscape Architecture (11:550)
30) Marine Science (11:628)
31) Leadership Skills (11:607)
32) Microbiology (11:680)
33) Nutritional Sciences (11:709)
34) Philosophy (50:730)
35) Planning and Public Policy (10:762)
36) Plant Science (11:776)
37) Supply Chain Management (29:799; 33:779)
38) Public Health (10:832)
39) Public Policy (10:833)
40) SEBS Internship (11:902)
41) Social Justice (01:904)
42) Sociology (01:920)
43) Spanish (01:940)
44) Urban Studies and Community Development (50:975)

WG3 has not yet compiled graduate level educational opportunities related to agriculture, food and water systems.

Informal education also happens through student clubs on campuses. Rutgers Compost Club, the Vegetarian Society, Food Science Club, are a few examples. Students for Environmental Awareness offer activities. Rutgers Day has been filled with agriculture and food related events for many years. Rutgers Global and Rutgers Entrepreneurship Club.

Informal education happens through Rutgers Day[26] and other events and programming. Beginner farmer programs, Master Gardener Programs, Environmental Stewards Program, water resource rain barrel and rain garden workshops, 4-H and other programming, are offered to New Jersey residents through Rutgers Cooperative Extension[27]. These programs provide formal and information learning opportunities for residents of the state. Recently, Rutgers Cooperative Extension started a webinar series "Earth Day, Every Day"[28] as part of their Environmental Stewards Programs. The Office of Continuing Professional Education (OCPE) and the Division of Continuing Education (DOCS)[29] also provide learning opportunities throughout life.

3.1.4.2 Research

Agriculture, food, and food systems research is currently on-going on all campuses and throughout the state. The Health Dining Team conducts research in Rutgers dining facilities to inform its work with the MCURC. Other research includes consulting with local municipalities, entrepreneurs, and businesses as well as farmers and household. The extension services in through NJAES and RCE are an important part of our research ecosystem. Research ranges from food production and innovation to food waste as well as nutrition and health education, community food insecurity and advocacy, environmental impacts, consumer behavior and economics, among other topics. Students participate in research efforts at the undergraduate and graduate level. For example, Rutgers faculty, with the assistance of student research assistants, are working on food waste reduction strategies, and are working closely with The Center for EcoTechnology[30] on recently funded research project to identify viable solutions for food waste prevention throughout the State of New Jersey. Another example is research undertaken by the Rutgers Healthy Dining Team.

Research related to agriculture, food and water, is conducted at the Institute for Food, Nutrition and Health through its multiple centers as well as departments housed in the School of Environmental and Biological Sciences and NJAES. Nutrition, Public Health and Public Policy research related to food are also conducted at many locations at Rutgers. WG3 has not yet made a full inventory of the research projects.

3.1.4.3 Services – Students, Faculty and Staff

Student food pantries play an important role in delivering food to food insecure students. No student should be food insecure so this finding presents a funding a priority for Rutgers[31]. Achieving food security[32] and access to healthy food remain important issues for our students and others in our communities.

Rutgers University also supports farmers markets as a mechanism to provide fresh, seasonal food to students, faculty and staff, and to our community neighbors. In collaboration with Johnson & Johnson and the City of New Brunswick, Rutgers Cooperative Extension organizes the New Brunswick Community Farmers Market (NBCFM), which increases fresh fruit and vegetable access for urban residents. The NBCFM accepts federal food assistance benefits and provides a matching incentive program to encourage

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[26] https://rutgersday.rutgers.edu/. The next Rutgers Day is virtual and is scheduled for Saturday, April, 24, 2021.
[27] https://njaes.rutgers.edu/extension/
[28] https://sebsnjaesnews.rutgers.edu/2020/09/rutgers-earth-day-every-day-fall-virtual-series-begins-september-14/
[29] https://docs.rutgers.edu/
[30] Website: https://www.centerforecotechnology.org/
[31] https://support.rutgers.edu/news-stories/givingtuesday2019/
[32] NJAES What is food insecurity? https://njaes.rutgers.edu/fchs/food-security.php

local and healthy food choices. In addition to programs that address food affordability, the NBCFM reduces food miles through collaborations with local farmers who provide produce through the market, and also via on-site community garden programs that allow local families to grow their own vegetables, herbs, and flowers. In 2019, the NBCFM served nearly 14,000 market customers across three locations in the City, and supported over 50 community gardeners on site. An ongoing partnership with the New Brunswick-based Rutgers Student Food Pantry increases fresh produce access for food-insecure students at both the NBCFM and Cook's Market, a SEBS-sponsored farmers market housed at Rutgers Gardens on Cook Campus.

3.1.4.4. Services- Communities

Institute for Food, Nutrition, and Health (IFNH) Center for Childhood Nutrition provides programs for public and private schools across New Jersey[33]. They also partner with state departments of health and senior services, foundations such as the Robert Wood Johnson Foundation, American Association of Pediatrics as well as community partners in other countries.

3.1.2.5 Services – Businesses and Entrepreneurs

Rutgers Food Innovation Centers (https://foodinnovation.rutgers.edu/) support food entrepreneurs in developing new food products, including sustainable and locally sources food products for the local, national and international markets. Space rental, training, business development, food accelerator programs and mentoring are found at these centers. The Impossible™ Burger, was brought to the Rutgers Food Innovation Center in Bridgeton, NJ for development and manufacturing (scale up) of their newly developed plant-based sustainable protein product while they were building their larger commercial facility[34].

Rutgers EcoComplex (https://ecocomplex.rutgers.edu/) is a "clean energy innovation center" dedicated to moving inventions from the lab to successful real world applications. The director, Serpil Guran, is one of the consortium members for State and Cities for Climate Action in the report "America's Zero Carbon Action Plan.[35]" The staff at the EcoComplex are available to work with entrepreneurs who have energy related projects that are connected to agriculture and food as well as water.

[33] Institute for Food, Nutrition, and Health (IFNH) Center for Childhood Nutrition
[34] https://foodinnovation.rutgers.edu/success-stories-and-testimonials/innovate-success-stories/
[35] https://ecocomplex.rutgers.edu/Documents/zero-carbon-action-plan.pdf

3.2. Overview of potential climate solutions

3.2.1. Potential solutions

WG3 climate solutions for consideration[36] are the following:

Menu enhancements and recipe changes
Dining services continually update and change their menus and there are many opportunities to change consumer behavior by leading with taste. We know that messaging around nutrition, health and climate change can turn consumers away so developing recipes that are delicious and also nutritious and climate-friendly should be our goal.

- Rutgers dining committed to 25% reduction in protein associated GHGs by 2030 (MCURC target); 20% reduction possible in next few years.
- Add more plant-forward/plant-rich recipes and dining options
- Promote meatless Mondays but continue to provide meatless and meat options on all days so customers can decide on which meatless meats
- Work with campus catering vendors to enhance plant-rich food options

Climate-friendly food labeling and corporate climate action

- Adoption of a climate-friendly labeling system for on online menus
- Explore labeling options at point of service
- Promote climate-friendly food products for sale in retail locations
- Encourage vendors to label climate-friendly food options on online menus

Climate-friendly food labeling is one of the newest innovations in food label. These are marketing labels that provide consumers with information that connects the food on its plate to the impact that food has on climate. Third party labels are just starting to appear in the marketplace. For example, on October 14, 2020, Panera, a food vendor at Rutgers and in the communities, announced that it is the first national restaurant to label climate friendly foods[37]. Panera has adopted WRI's "cool food meal" label (see Fig. 3.6) which is part of the Cool Food Pledge. The carbon footprint for its meals were calculated by WRI staff and Pure Strategies with information provided by Panera Chefs[38]. As of October 2020, Panera claims that 55% of the entrees on their menu are low carbon Cool Food Meals. According to this website (https://www.panerabread.com/en-us/articles/climate-friendly-meals.html) :

> The World Resources Institute (WRI) has established a maximum recommended daily carbon footprint for a person's diet, which is 38% smaller than the current average diet. This is in line with what WRI's research has found is needed by 2030 to help mitigate the worst forms of climate change. A breakfast's carbon footprint must be no more than 20% of the recommended daily carbon footprint of a person's diet, and a lunch or dinner no more than 30%. If emissions are below a maximum per-meal greenhouse gas threshold and meet a nutritional safeguard, it is certified as a Cool Food Meal. To learn more visit www.coolfood.org.

[36] Note: other solutions were considered but are not listed here.
[37] Panera Bread. PRNewswire. October 14, 2020. *Panera is the First National Restaurant Company to Label Climate-Friendly "Cool Food Meals" on Menu, Empowering Customers to Know the Impact of Their Plate.* https://www.prnewswire.com/news-releases/panera-is-the-first-national-restaurant-company-to-label-climate-friendly-cool-food-meals-on-menu-empowering-consumers-to-know-the-impact-of-their-plate-301151925.html
[38] Panera Bread. Low Carbon Cool Food Meals. https://www.panerabread.com/en-us/articles/climate-friendly-meals.html

It is still too early to tell is this label or other climate-friendly labels will be adopted and recognized by consumers. The adoption by Panera is likely to have some impact since they serve. Additionally, it is unclear if climate friendly labels will change customer behaviors and lead to reduced carbon footprint from food[39,40]. Rutgers has the expertise to research climate-friendly food labels and determine their impact on customer behavior.

Fig. 3.6. Cool Food Meal icon.

Starbucks, another vendor in the Rutgers Food System, has also made a pledge in early 2020 to become "resource positive"[41]. This means it will implement practices that stores more carbon than it emits, eliminates food waste and provides more freshwater than it uses. The formal plan for Starbucks will be released in March 2021.

Education and awareness campaigns around:

- Food choices on campus: Lead with taste and the rest will follow
- Food waste reduction including reduce plate waste and source reduction
    - Broadly adopt "Stop Food Waste Day" during Earth Month, starting 28 April 2021[42]
- Continue to promote Meatless Mondays
- Promote metal water refillable bottles (potential to reduce GHG to $1/300^{th}$ of single use plastic bottles)
- Use farmers markets for outreach
- Build Rutgers Dining demonstration facilities for teaching cooking skills

Reduction of consumable goods especially those associated with food takeout/convenience or catering

- Plastic cutlery only available if requested (not by default)
- Promote reusable bags

Refrigeration management

- Comply with Federal Rules for refrigeration and decommissioning of refrigeration/cooling units
- Encourage students to only rent Rutgers-approved student fridge/microwaves in student housing (approval process should included GHG considerations)

Continue to support purchased from local supply chain when in season
Enhance outreach and explore incentives for better farming systems, food production systems, local food products, delivery methods with local supply chains, and cooking for Rutgers-sourced food

[39] https://www.cnbc.com/2020/10/14/panera-bread-to-label-entrees-as-climate-friendly.html
[40] Personal communication from Richard Waite, WRI to Xenia Morin.
[41] Amelia Lucas, CNBC. *Starbucks aims to become "resource positive' in climate push.* Jan 21 2020. https://www.cnbc.com/2020/01/21/starbucks-aims-to-become-resource-positive-in-climate-push.html
[42] https://www.stopfoodwasteday.com/en/index.html

- Food demonstration facilities that address sustainable solutions
    - Rutgers Food Innovation Center
    - Rutgers Food Innovation Center
- Extension Faculty research and development

3.2.2. Cross-Cutting Solutions

3.2.2.1 WG3 with implications for Working Group 2:

- **Electrification of the vehicle fleet**
- **Transportation for students, both on and off-campus (but near campus) to travel to grocery stores via public transportation**

3.2.2.4. WG3 working in conjunction with Working Group 4:

- **Food**: Build on strong current efforts on food waste reduction
    - Campus-based options
    - Explore community collaborations around food waste and organic waste management
- **Equipment:** Energy Star ratings wherever possible
- **Contracts with Food and Beverage Vendors: Explore additional contract language**
- **Anaerobic digestion**
    - Advantages OF AD
        1. It's an 'old' technology (well-known)
        2. Can be used to process fats, oils, greases, and biosolids, in addition to 'regular' biomass
        3. Produces methane gas that can be captured and used as an energy source
        4. Can help reduce carbon emission by offsetting the use of fossil fuels
        5. Digestate can be used as livestock bedding, flower pots, fertilizer, soil amendments, etc.
        6. Contributes to a more circular waste handling system
        7. Can be an educational and research tool for SEBS
        8. Can contribute to a positive image for the University
    - Challenges for AD
        1. Changes in feedstocks can have a major impact on the process
        2. There's a certain amount of 'art' involved in managing the process (i.e., requires a skilled operator)
        3. Potential for the release of odors
        4. Typical design: Feedstock/digestate needs to be pumpable
        5. Takes time to complete the processing cycle
        6. Process occurs in an oxygen deprived environment that requires proper sealing (health risk to humans)
        7. Process requires temperature control for maximum efficiency
        8. Process requires pH control for maximum efficiency
        9. At the end of the process, digestate requires additional processing (including dewatering)
        10. Depending on feedstock, digestate may contain a variety of harmful constituents (e.g., pesticides, herbicides, heavy metals, chemicals, drugs)

Waste Stream: Most of our peer institutions have committed to significantly reducing waste on their campuses through increased recycling and composting, and reduced purchasing of disposable items such as dining ware. Recognizing that a waste audit is the first step in reducing waste, Cornell University, University of Pennsylvania and Syracuse have all engaged in extensive waste audits and assessment of GHGs associated with their waste. For the most part, peer institutions have taken an incremental approach to reducing waste as part of their Climate Action Plans. For example, the University of Pennsylvania's Climate Action Plan seeks to increase their recycling rate from 24%, to 30% by 2019, and continue to reduce overall municipal solid waste. Furthermore, the Office of the President committed to zero waste administrative events, thereby demonstrating feasibility and leadership at their institution. By establishing a Zero Waste goal, Rutgers University would become among the leaders of our peer institutions in waste reduction.

In the following pages, we address the Supply Chain and Waste Stream categories for which recommendations are made. In each of these sections we discuss: the current status of the category at Rutgers or, "Where We Are"; our overall assessment of key goals or, "Where We Want to Be" and a list of explicit recommendations or, "How To Get There".

3.2.2. Stakeholder Input

WG3 provided questions for the Climate Task Force Survey administered in August – September 2020. Approximately 8,843 responses from students, faculty and staff were received and are currently being analyzed. Some preliminary data analysis by WG3 has begun for Section 3 on Food and Water.

WG3 also have engaged with Gourmet Dining, our food service provider in Newark and in Camden as well as athletics. Through Gourmet Dining, WG3 is making connections to the sustainability group at Compass Group USA.

3.2.3. Early opportunities for action

The Working Group 3 and in some cases, Working Group 3 and 4, teams identified solutions with low financial costs and low institutional barriers that could potentially be completed before the completion of the Climate Action Plan.

	From (years)	**From (years)**	**Solution**
Short Term	0	1	Rutgers Dining recipe evaluation with enhancement of plant forward/plant-rich recipes, and reduction of chicken and beef in recipes by 20%
Short Term	0	1	Create an awareness campaign for sustainability, including using refillable water bottles, and food waste reduction for all students, faculty and staff Promote STOP FOOD WASTE DAY in April 21, 2021 Participate in Virtual Rutgers Day, April 24, 2021
Short Term	0	1	Posting maps of locations of food service operations, hydration stations and vending machines on Rutgers Sustainability website. Include sustainability information.
Medium Term	0	2	Eliminate single use plastic bags for takeout for food service establishments in campus facilities
Medium Term	0	2	Work with Residence Life and Student Affairs to ensure proper management, maintenance and disposal of refrigeration units brought to campus by students.

3.2.4. Cross-cutting issues arising in the exploration of potential solutions

Working Group 3 and 4 worked on food waste as a cross-cutting topic. Rutgers University's dining halls create approx. 2,000 tons of organic waste per year. Presently, some food service operations aerobically digest the food waste before disposal into the wastewater system. Some portion of the organic food waste is being picked up by a local pig farmer and utilized as feed for the animals. Rutgers Dining Services has concern that the pig farmer may not continue to receive the waste and this underlines the importance of a sustainable need for a holistic solution to utilize food waste to generate low carbon electricity and produce low- carbon organic fertilizer. In collaboration with Working Group 3 (Food and Water Systems), we believe Rutgers campuses can demonstrate such conversion by utilizing state-of-the-art anaerobic digestion technology that food waste can be converted into low-carbon energy and low-carbon fertilizer as one of the emerging "Circular Carbon Systems."

3.3. Assessments of potential climate solutions

3.3.1. Menu enhancements and recipe changes

- Rutgers dining committed to 25% reduction in protein associated GHGs by 2030 (MCURC target); 20% reduction possible in next few years.
- Add more plant-forward/plant-rich recipes and dining options
- Promote meatless Mondays but continue to provide meatless and meat options on all days so customers can decide on which meatless meats
- Work with campus catering vendors to enhance plant-rich food options

3.3.1.1. Emissions reductions and resilience improvements

Emissions reductions from a reduction of beef and chicken in recipes. A 20% reduction in beef and chicken in recipes are easy to achieve without impacting the dish. Since these two items make up 70% of current emissions, the reduction is estimated to be 14% within a few years. Promotion of Meatless Monday and meatless dining options may also bring down emissions by shifting the diet to "climate-friendly" options. Through MRUCR, in 2019 Rutgers Dining has committed to a 25% reduction in protein-related emissions by 2030. Resiliency improvements have not been assessed. It is important to maintain and/or enhance health and nutritious food options while promoting climate-friendly menus.

3.3.1.2. Financial costs and savings

Plant-forward/plant-based recipes may require more labor for preparation and may increase costs for preparation, but increases may be off-set by the cost of the ingredients. Recipes changes may be driven, in part, by cost considerations to keep meal plans affordable and accessible for students.

3.3.1.3. Benefits to the University's educational and research mission and to campus culture

Supports health eating initiatives and provides opportunities for studying college student food choices. A socio-ecological model can look at food systems drivers of food choices. Healthy food choices are welcomed by students and change the campus food culture. There is the potential to enhance our research by working with companies in food service who are making menu changes (e.g. Panera) or groups who are supporting sustainable diets (e.g. World Resources Institute).

3.3.1.4. Other Co-Benefits:

Successes can be shared through MCURC and with Gourmet Dining and outside vendors. These low emissions food recipes may impact other campus dining activities across all campuses as well as at other colleges and universities. **Rutgers can continue to be a leader in this area.** Potential for improvement in student achievement due to healthy eating may be a co-benefit. Environmental Impact of food choices will be reduced.

3.3.1.5. Implementation Plan and Timescale:

Can start at any time if staffing is available. It is important to lead with taste to develop our recipes. This can be part of a continuous improvement plan. Rutgers Food Innovation Center might have a role to play as well.

3.3.1.6. Needed research and planning

Rutgers Dining will lead the research and planning and may work with partners in the Menus of Change

3.3.1.7. Evaluation plan

To be developed by Rutgers Dining and IFNH.

3.3.1.8. Management roles

Rutgers Dining; Procurement

3.3.1.9. Institutional, Organizational and Cultural Challenges to Implementation

These changes will need to be accompanied by awareness and marketing campaigns. Our tasty, healthy and climate-friendly food offerings can also be used as a recruiting tool for Rutgers Admissions.

3.3.1.10. Participation and Accountability

Rutgers Dining. With buy-in, Gourmet Dining, LLC. and other campus vendors.

3.3.1.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development

Potential to increase demand of local vegetables and fruits and other food products.

3.3.1.12. Equity Concerns

Not all dining halls will be able to adopt changes at the same rate. Some students may feel like they do not have access to these food options. We will need to work with Gourmet Dining to ensure that students at other campuses have equal access.

3.3.2 Climate-friendly food labeling

- Adoption of a climate-friendly labeling system for on online menus
- Explore labeling options at point of service
- Promote climate-friendly food products for sale in retail locations
- Encourage vendors to label climate-friendly food options on online menus

3.3.2.1. Emissions reductions and resilience improvements:

To achieve goals of 1.5C warming, it is estimated that the average American diet will need to reduce its food footprint by 38% (WRI) by shifting to lower emissions meals. It is currently unknown what is possible in campus dining using labeling but student who are interested in reducing their food footprint may find this label useful. Because students have access to information online, addition of this label may draw attention to climate-friendly food menu items. Note that vegetarian and vegan options are already labeled. Taste and nutrition should also be considerations when adopting this label.

3.3.2.2. Financial costs and savings

There are few expenses associated with adding labels to existing websites with known climate-friendly meals. Costs will be incurred if emissions need to be evaluated for individual ingredients. Costs may increase for food suppliers and food vendors if they wish to obtain this label and these costs may be passed along to consumers in our retail stores and dining halls. A marketing campaign will be needed to introduce this label and the costs are unknown because the scope is unclear.

3.3.2.3. Benefits to the University's educational and research mission and to campus culture

The impact of these labels in changing food choices is currently unknow and provide opportunities for formal and informal education as well as research and funding opportunities. Online labeling is the easiest and provides quick educational access. It is unclear if point of sale labeling will make an impact as it depends on the level of signage in the food environment. Benefits to the campus culture include promoting our climate friendly approach to food.

3.3.2.4. Other Co-Benefits
Many climate-friendly meals are also healthy options. Student health may be enhanced by students choosing these labels. Other food service companies and food products who promote this labeling, will also draw attention to Rutgers efforts, and vice-versa.

3.3.2.5. Implementation Plan and Timescale
Implementation begins with an evaluation of existing “climate-friendly” labels will need to be undertaken. Whatever label is adopted should be one that is expected to become an industry standard so that it will be easy to find beyond Rutgers Dining.

3.3.2.6. Needed research and planning
Rutgers Dining and IFNH

3.3.2.7. Evaluation plan
Rutgers Dining and IFNH

3.3.2.8. Management roles
Rutgers Dining and IFNH

3.3.2.9. Institutional, Organizational and Cultural Challenges to Implementation
None at this time.

3.3.2.10. Participation and Accountability
Rutgers Dining and IFNH, Procurement

3.3.2.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development
Provide opportunities for food vendors and suppliers to identify their foods as “climate friendly” by adopting this labeling.

3.3.2.12. Equity Concerns
None identified so far, however, if these food cost more, lower income students may find these items unaffordable.

3.3.3. Refrigeration management
- Comply with Federal Rules for refrigeration and decommissioning of refrigeration/cooling units
- Encourage students to only rent Rutgers-approved student fridge/microwaves in student housing (approval process should included GHG considerations)

3.3.3.1. Emissions reductions and resilience improvements
Federal and state regulations govern this solution and the university is in compliance. Encouraging the renting of student refrigerators will reduce the need for refrigerants and the potential for refrigerant release.

3.3.3.2. Financial costs and savings
Unknown. An awareness campaign is needed for proper maintenance and disposal is needed. The cost is unknown. There may be additional costs to students for renting vs. purchase of small refrigerators.

3.3.3.3. Benefits to the University's educational and research mission and to campus culture

Student refrigerator use may change if they become aware of these impacts. We would encourage renting fridges rather than purchase if living in student housing.

3.3.3.4. Other Co-Benefits

Reduced energy costs might be possible if upgrades in refrigeration and cold storage units are made.

3.3.3.5. Implementation Plan and Timescale

TBD

3.3.3.6. Needed research and planning

Further work by the climate task force needs to be done to understand the scope of this solution and the urgency. Because of the high GWP of refrigerants, reducing the release of even small levels of refrigerants can make an impact.

3.3.3.7. Evaluation plan

TBD

3.3.3.8. Management roles

Facilities, Student Affairs, REHS.

3.3.3.9. Institutional, Organizational and Cultural Challenges to Implementation

Student refrigerators are a mainstay in many dorms and off campus housing. Reducing the number of student refrigerators that are purchased may be a change but offers cost savings and disposal issues.

3.3.3.10. Participation and Accountability

TBD

3.3.3.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development

TBD

3.3.3.12. Equity Concerns

TBD

APPENDIX A – Background Information

Climate solutions associated with food will need to come from a number of different areas within the food system (Fig. 3A.1). Globally, approximately 26% of greenhouse gas emissions (GHGs) are associated with food production with 8% of global total coming from food waste. GHG emissions associated with food come many resources: food production methods that consume energy, water, soil and land area; packaging; food decomposition (especially in landfills), to the chemical used in refrigeration (see Fig 3A.2 for some examples). It will take a lot of different people working together toward a more sustainable and climate-friendly food system to bring about climate solutions for the food system. Food justice, food security, and food equity[43] are also factors that must be considered when implementing change.

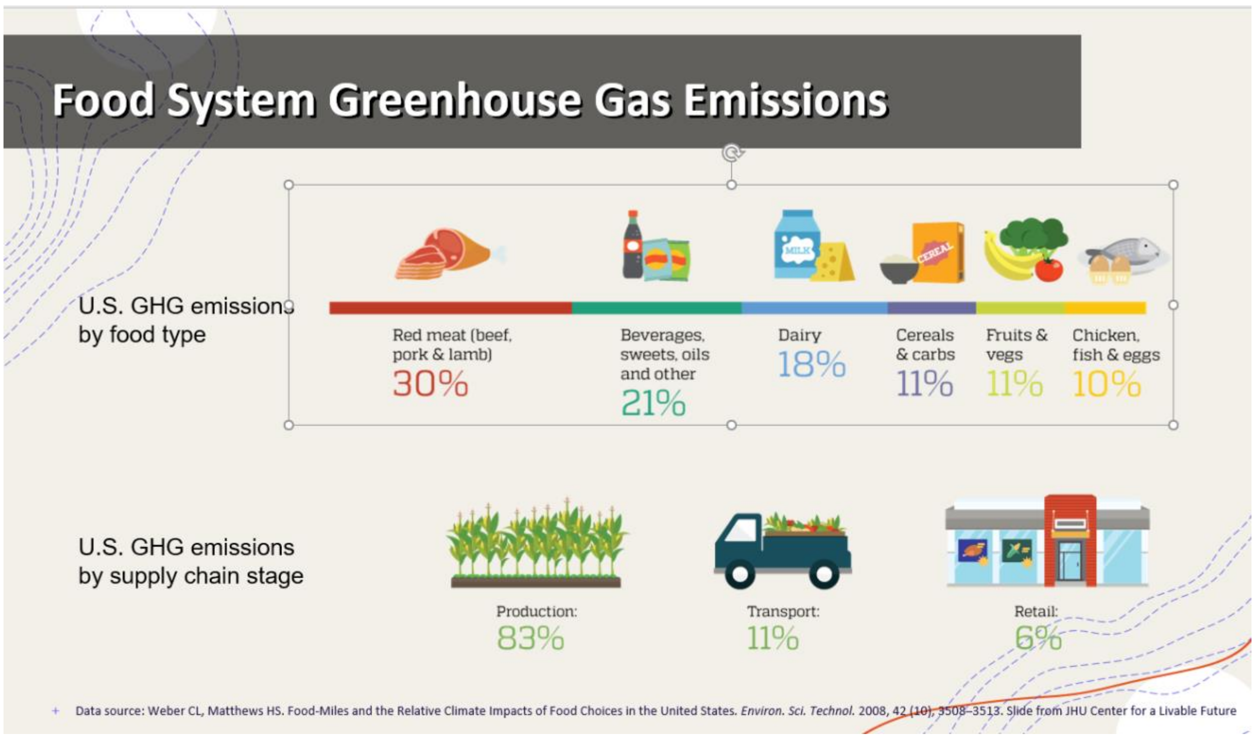
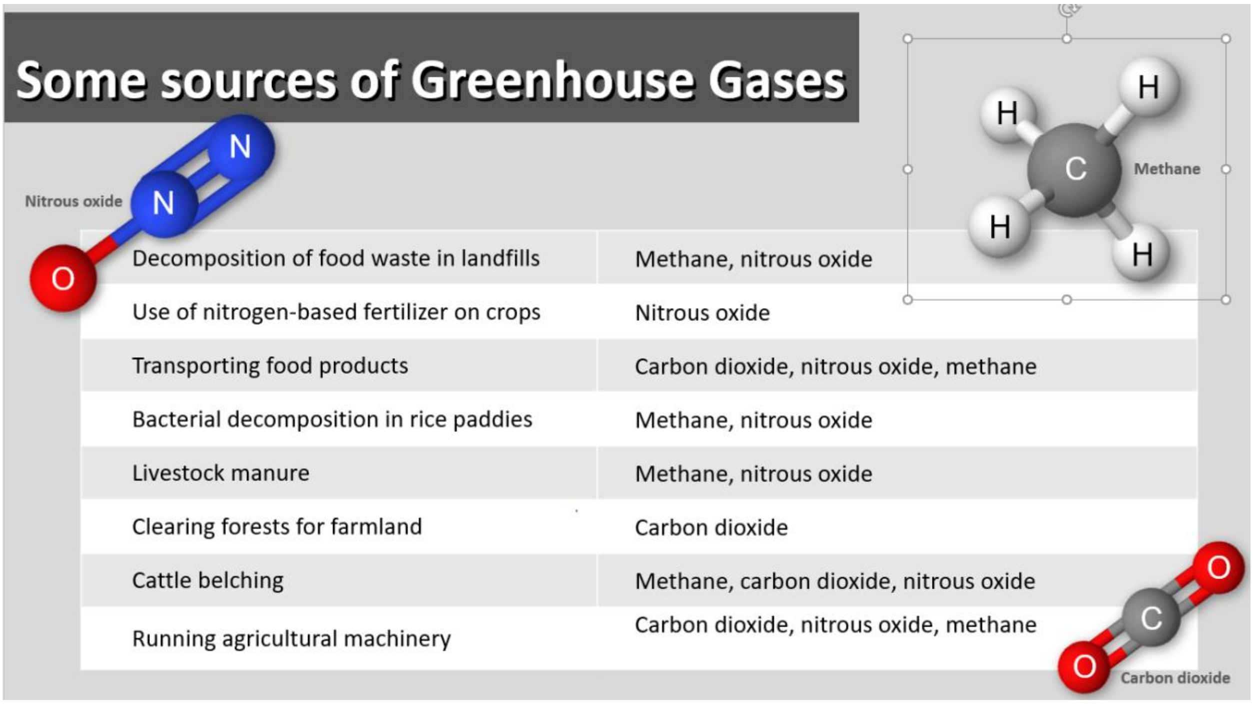


Figure 3A.1. Summary of the GHG emissions by food type and supply chain. Note that a major contributor to GHG in production is fertilizer use. Source: Weber et al (2008).

[43] For more about food justice, food security, and food equity, see: https://foodprint.org/issues/food-justice/ and this video "Food for Thought: The Path to Food Security in Newark" (https://youtu.be/hZLgLFOAcrs). Also note that many of our students work in the food system, both on- and off-campus, so these issues impact them directly.



Decomposition of food waste in landfills	Methane, nitrous oxide
Use of nitrogen-based fertilizer on crops	Nitrous oxide
Transporting food products	Carbon dioxide, nitrous oxide, methane
Bacterial decomposition in rice paddies	Methane, nitrous oxide
Livestock manure	Methane, nitrous oxide
Clearing forests for farmland	Carbon dioxide
Cattle belching	Methane, carbon dioxide, nitrous oxide
Running agricultural machinery	Carbon dioxide, nitrous oxide, methane

Figure 3A.2. Greenhouse gas emission reductions possible from food. Not shown are fluorinated gases such as hydrofluorocarbon refrigerants. (Image Source: Johns Hopkins Center for Livable Future).

One of the largest contributors of GHG emission in the U.S. is food waste which produces methane when it decomposes[44]. Given that an estimated one-third of food that is produced is lost or goes to waste, there are many opportunities to reduce GHGs through food waste reduction[45,46,47]. Food production also contributes additional environmental impacts including high freshwater use, changes in land use, pollution of water ways, and impacts on biodiversity. ReFED has estimated that food waste consume 21% of all freshwater, 19% of all fertilizer, 18% of cropland, and occupies 21% of landfill volume nationally and a 2017 study in New Jersey found that 25% of our landfill waste is food waste[48]. Nationally, residential food waste contributes significantly to landfills ((Fig 3A.2)[49] Reducing of food waste on campus and in our homes will not only reduce GHG emissions, but it can positively impact many environmental factors as well.

Future food waste reduction initiatives support by Rutgers will also support the USDA, EPA[50] and State of New Jersey's new food waste reduction plan[51] to achieve a 50% reduction in food waste by 2030. Currently,

[44] The global warming potential (GWP) for methane can be calculated in several ways (e.g. GWP100, GWP*) and this can have an impact on calculations for net zero emissions over time, for example see: https://iopscience.iop.org/article/10.1088/1748-9326/ab6d7e

[45] Project Drawdown, Solutions: Reduce Food Waste. https://drawdown.org/solutions/reduced-food-waste

[46] NRDC Food Waste. https://www.nrdc.org/food-waste .

[47] ReFED 27 Solutions to Food Waste, Emissions Reduction. https://www.refed.com/?sort=emissions-reduced

[48]NJ Department of Environmental Protect. Focus on Food Waste. https://www.state.nj.us/dep/dshw/recycling/Foodwaste.pdf

[49] Advancing Sustainable Materials Management: 2018 Fact Sheet (EPA, Nov. 2020): https://www.epa.gov/sites/production/files/2020-11/documents/2018_ff_fact_sheet.pdf

[50] United States Food Loss and Waste 2030 Champions: https://www.epa.gov/sustainable-management-food/united-states-food-loss-and-waste-2030-champions

[51]State of New Jersey, Department of Environmental Protection, Food Waste Plan. https://www.nj.gov/dep/dshw/food-waste/ and https://www.nj.gov/dep/dshw/food-waste/food_waste_reduction_plan.html

a majority of the food waste generated in the in the United States ends up in landfills (see Fig. 3.2) and contributes to methane production.

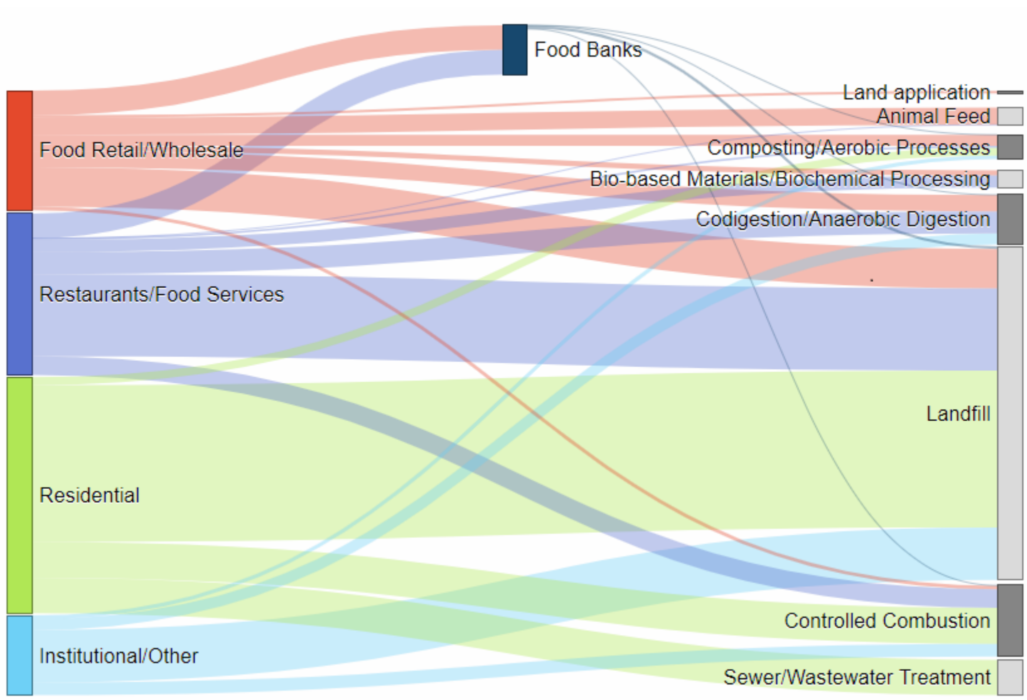


Figure. 3A.3. Wasted Food Generation and Management Flows (2018 estimates). Source: EPA (https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/food-material-specific-data)

There is much more that can be done to further reduce Rutgers food systems' impact on climate change.

A.1. Background on Indirect Emissions from Food

There are significant differences in the GHG emissions associated different foods (see Fig 3A.4) and with different with food production methods52, and to standardize calculations and allow for comparison with other schools, the SIMAP® carbon and nitrogen-accounting platform53 was used to calculate GHG emissions from food sourced by Rutgers Dining. SIMAP requires that we be able to provide information on the food product, the weight or volume of purchase, whether the food was local (<250 miles) and/or certified organic. One challenge in calculating GHG emissions is that food purchases may change with the seasons so some estimates have been made to reflect net purchases over 2018-2019 (FY2019).

[52] Poore and Nemecek (2018) Reducing food's environmental impact through producers and consumers. *Science* Vol. 360 (6392), pp. 987-992. DOI: 10.1126/science.aaq0216. https://science.sciencemag.org/content/360/6392/987
[53] SIMAP® Homepage: https://unhsimap.org/home

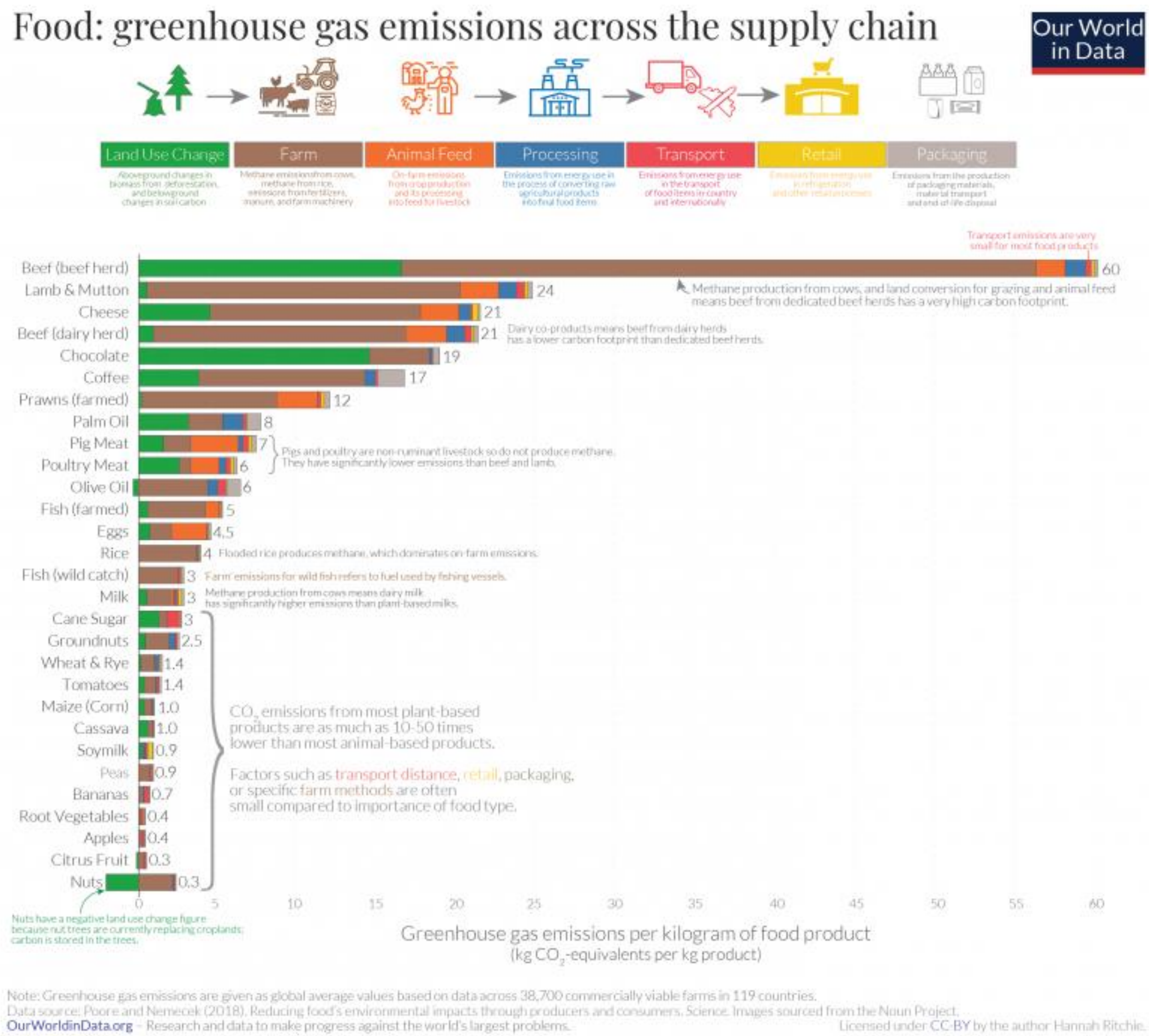


Figure 3A.4. Greenhouse gas emission per kilogram of food product across the supply chain. From: https://ourworldindata.org/food-choice-vs-eating-local . Data source: Poore and Nemecek (2018) as produced by OurWorldinData.org.

A.2. Refrigeration and the Cold Supply Chain

GHG emissions are also associated with refrigeration and the cold supply chain[54]. These emissions are associated with the energy used for cooling and maintenance of cold or freezing temperatures, as well as emissions associated with the inadvertent release of refrigerant compounds. According to Project Drawdown, older refrigerants, CFCs and HCFCs, which caused ozone depletion were replaced by HFCs under the Montreal Protocol. HFCS spare the ozone layer but have very high global warming potential (GWP) compared to CO_2 (1,000-9,000 times) and must be handled carefully to prevent release. An amendment to the Montreal Protocol was negotiated in 2016 with phase outs in the U.S. beginning in 2019.

[54] Hu et al (2019). Potentials of GHG emission reductions from cold chain systems: Case studies of China and the United States. J. Cleaner Production. Vol. 239, 1. https://doi.org/10.1016/j.jclepro.2019.118053 https://www.sciencedirect.com/science/article/abs/pii/S0959652619329233?via%3Dihub

Substitutes are now on the market. Great care must be taken at the end of the refrigeration equipment's life to ensure that these chemicals are not released but instead reused or transformed into compounds that no longer cause warming[55]. NJ DEP and EPA oversee refrigerant handling. isposal of any refrigeration units should be done under supervision according to regulations[56].

A.3. Food Waste Reduction

Source reduction initiatives are at the forefront of waste reduction strategies in Higher Education institutions. Many approaches have been undertaken. For a full view of strategies that are being used please refer to ReFED, a non-profit organization committed to reducing food waste ReFED has released a summary of 27 Solutions to food waste these are summarized in Figure 3A.5 and include education campaigns, waste tracking & analytics, centralized anaerobic digestion and composting. The National Research Defense Fund (NRDC), another non-profit has also released reports in 2012 and 2017 on food loss and waste recovery[57] and they have framed the need to reduce effectively using graphics such as in Fig 3A.5.

The EPA has also crafted the Food Recovery Hierarchy (Fig 3A.5), and this provides useful guidance for determining where to intervene. Source reduction is the most preferred method to reduce food waste and greenhouse gas emissions.

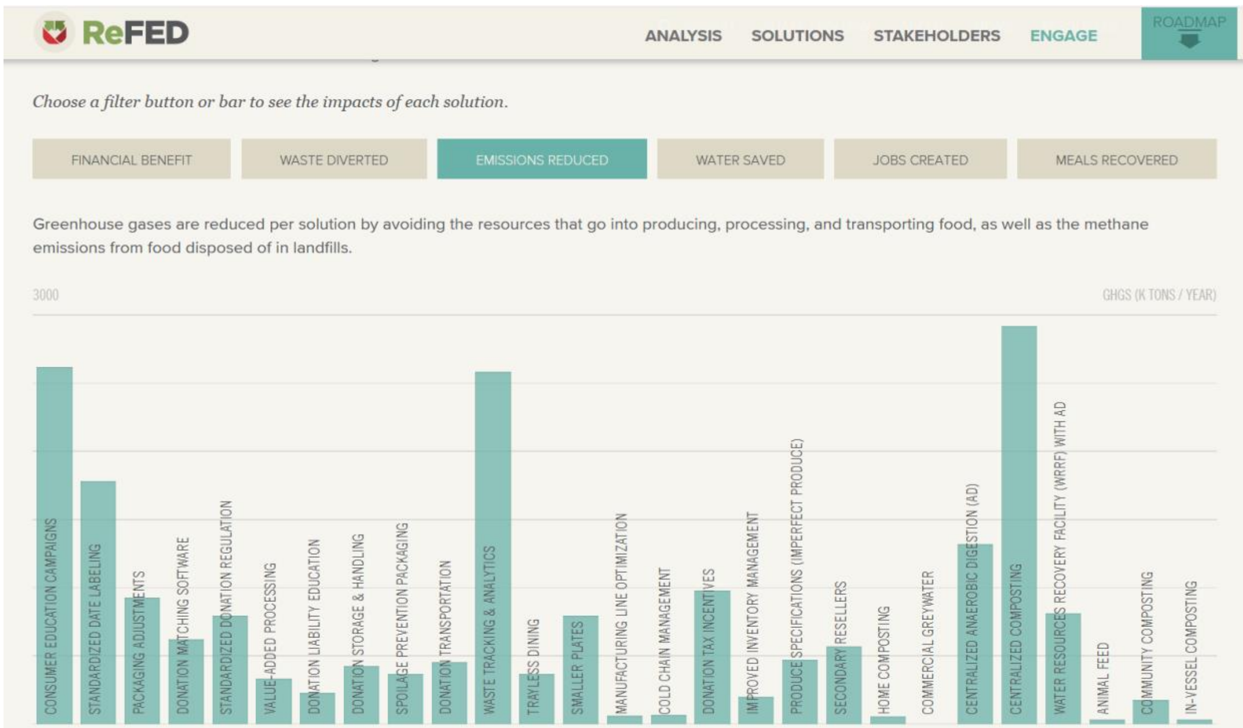


Figure 3A.5. 27 solutions for food waste reduction. Source: ReFED https://www.refed.com/?sort=emissions-reduced

[55] Project Drawdown, Refrigerant Management. https://drawdown.org/solutions/refrigerant-management
[56] https://www.epa.gov/section608/revised-section-608-refrigerant-management-regulations
[57] NRDC 2017 Report: https://www.nrdc.org/experts/andrea-spacht/report-wasted

Figure 3A.6. NRDC “More than Just Foods” graphics from their 2017 report “Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill“ (source: https://www.nrdc.org/experts/andrea-spacht/report-wasted).

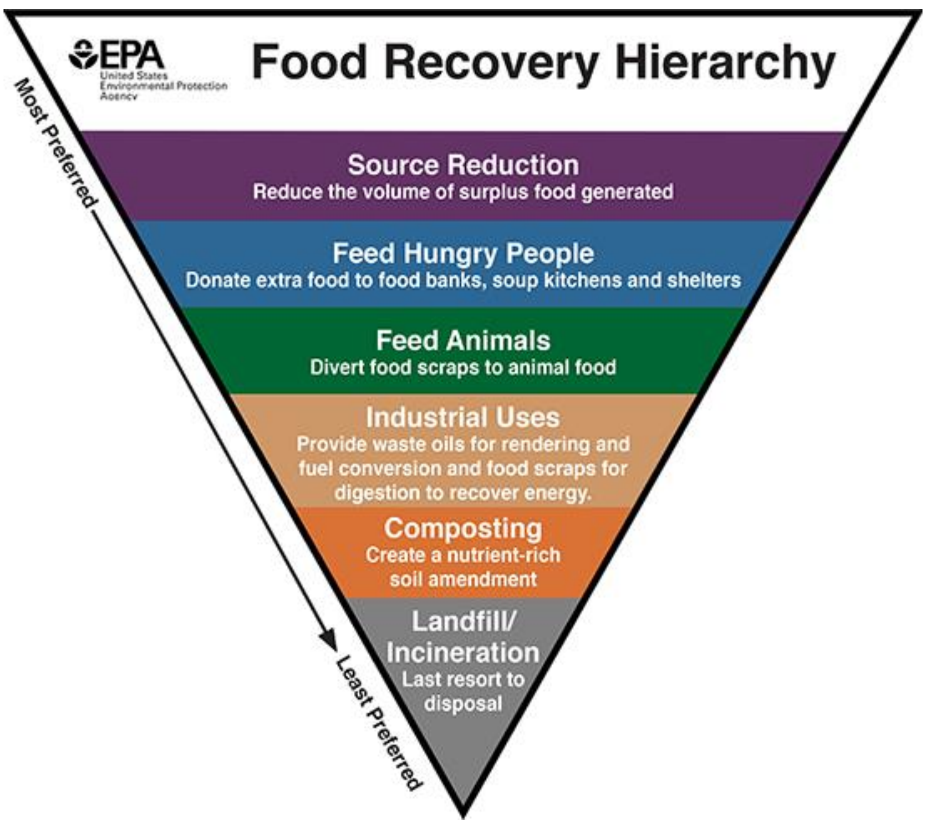


Figure 3A.7. EPA Food Recovery Hierarchy can be used as a framework for targeting food waste priorities and activities. Most to least preferred activities are indicated on the left side. Source: https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy

APPENDIX B – Water Systems

Working Group 3 looked at the water available for drinking at all three campus locations in response to Town Hall meeting feedback in February 2020 in which some were concerned about lead in the water. Greatest concern over lead came from the Newark and Camden campuses. To date, only one building on the Newark campus was identified to have lead service lines. These lines were replaced in 2020.

One of the ways that we can reduce greenhouse gas emissions is to reduce the amount of plastic water bottles used on campus. To do this people will need alternative sources of drinking water that they trust and meet their needs with respect to quality.

Stormwater management, and combined sewer overflow, is another water priority related to climate change. Poor stormwater management in once place and have impact of drinking water elsewhere.

Rutgers Facilities and Rutgers Environmental Health and Safety Offices (REHS) oversee the water systems on Rutgers campuses. Facilities maintains the systems and REHS is responsible for testing and monitoring where required. For example, REHS tests tap water in childcare centers. Rutgers facilities and REHS have been responsible for adding water fill stations in all new buildings and replacing older water fountains with refill stations.

This appendix provides information on the public water systems that deliver water to our main campuses. Other water systems, such as well water, supply off-campus water to our farms, gardens, etc.

Public utilities supply the water in Newark, Camden, New Brunswick and Piscataway which use surface, reservoirs, and well water. Rutgers expects these utilities to meet federally mandated standard, which they do, and reviews data from yearly water quality reports and from this website in real time https://www9.state.nj.us/DEP_WaterWatch_public/[58]. When there are changes in water quality, they are often associated with surface water disinfection or flushing of water systems.

Drinking Water is regulated under the Federal Safe Water Drinking Water Act (SDWA) and drinking water must meet these standards. Reporting is required and made available to the public on the EPA website "Ground Water and Drinking Water" (https://www.epa.gov/ground-water-and-drinking-water). This website provides information about your drinking water.

Some members of the Rutgers community expressed their concern in townhall meetings in early 2020 about lead contamination in the water. WG3 explored this topic. The City of Newark has reported lead in the water and has undertaken an extensive lead service line replacement program. Lead service lines have been identified as the main source of lead in residential buildings in Newark. Only one Rutgers building on James Street in Newark has lead service lines and this line was replaced in 2020[59]. Corrosion control inhibitors are also used in public utility systems to reduce lead in the water and our high use of water on campuses ensure that the water moves through the systems.

Recently the New Jersey Department of Environmental Protection established health-based drinking water standards for perfluorooctanic acid (PFOS) and perfluorooctane sulfonic acid (PFOS), two extremely persistent chemicals in the environment that have been linked to health issues in people. New Jersey leads

[58] Personal communication, Mark McLean, REHS, October 30, 2020

[59] Personal communication, Mark McLean, REHS, October 30, 2020.

the nation in setting stringent standards for these two chemicals and the public will now have access to data regarding these potential drinking water contaminants.[60]

This report extends beyond food to include an evaluation of our drinking water systems since reduction in the use of single use water bottles provides an opportunity for GHG reductions. GHG emissions associated with single use water bottles come from the fossil fuels used to create the plastic bottle as well as the cold storage and transportation in the supply chain.

[60] Affirming National Leadership Role, New Jersey Publishes Formal Stringent Drinking Water Standards for PFOA and PFOA. NJ Department of Environmenal Protection Press Release, June 1, 2020. (https://www.nj.gov/dep/newsrel/2020/20_0025.htm)

Table 3B.1. Water Source and Quality Data for the Main Campuses at Rutgers

Campus	Water Source and Public Utility	Water Quality Information and Water Quality Reports, Plans and Violations	Recent Action
Newark	Newark Water & Sewer, Newark Water Department https://www.newarknj.gov/departments/water_sewer Rutgers main campus water source: Wanaque water system which draws from surface waters (rivers, streams, reservoir):	**https://www9.state.nj.us/DEP_WaterWatch_public/** Public water systems identification number (PWSID): NJ0714001[61] Lead service line replacement service: https://www.newarkleadserviceline.com 15,776 out of approx. 18,000 lead service lines replaced as of October 30, 2020 Annual Water Quality Report (most recent 2018): https://waterandsewer.newarknj.gov/annual-water-quality-reports 2016 Stormwater and Combined Sewer Overflow (CSO) Pollution Prevention Plan https://drive.google.com/file/d/0B7x3Nz0vg2ucczU1dDZpeVdVV2M/view	Replacement of one lead service line on James Street completed; all other service lines to Rutgers buildings do not have lead service lines[62].
New Brunswick (New Brunswick)	New Brunswick	**https://www9.state.nj.us/DEP_WaterWatch_public/** Public water systems identification number (PWSID): NJ1214001	2019: came into compliance for surface water violations.
New Brunswick (Piscataway)	Piscataway	**https://www9.state.nj.us/DEP_WaterWatch_public/** Public water systems identification number (PWSID): NJ2004002	
Camden	City of Camden through a service contract with New Jersey American Water	**https://www9.state.nj.us/DEP_WaterWatch_public/** Public water systems identification number (PWSID): NJ0408001 New Jersey American Water 2020 Annual Water Quality Report, Western System (PWS032700): https://www.ci.camden.nj.us/wp-content/uploads/2020/10/wqr2020.pdf	Lead service line replacement

[61] Personal communication, Mark McLean, REHS, October 30, 2020.
[62] Personal communication, Mark McLean, REHS, October 30, 2020

Water Sources and Quality: Rutgers- Newark

Elevated levels of lead in Newark's water has been a prevalent conversation for years. However, drinking water at Rutgers, Newark is mainly (including all residential buildings) sourced by the Wanaque Water System, which has not been contaminated with lead. This water comes from the Wanaque Reservoir, which gets water from the Ramapo and Pompton rivers. The Pequannock Water System also serves some buildings on the Newark campus, but because they do not have lead service lines, lead in drinking water is still not an issue for Rutgers students. Based on the latest available Water Quality Report conducted by the City of Newark (2018), lead was the only contaminant existing in dangerous qualities. In response, the City of Newark has had an aggressive program to replace lead service lines (the main source of water contamination) and only one service line for a Rutgers owned facility on James Street was identified as needing replaced. This replacement was performed in 2020. Off-campus, the status of lead replacement lines can be found here: https://www.newarkleadserviceline.com/ . Water quality issues such as taste and odor may be due to disinfection byproducts.

Water Sources and Quality: Rutgers- Camden

Next is the water sources and quality at Rutgers Camden. New Jersey American Water is the contracted water system by the City of Camden and provides water from surface water, including a reservoir, and wells. As of 2019, Camden's water meets all the government requirements for contaminants. Therefore, the water is safe to drink. Issues with taste and odor are related to disinfection by product from surface waters.

Water Sources and Quality: Rutgers – New Brunswick (Piscataway)

The main water source from the Piscataway township is the Raritan River Watership. In 2019, the Raritan headquarters graded the Raritan Watershed water quality and the rating was a C. The reason for this rating stems from the poorly planned policy decisions at the local and state level, causing the region's waterways pollution from irresponsible management of hazardous fertilizers, pesticides and other sources. In addition, the Piscataway township consists of Piscataway Twp consists of 4 non-community water systems, consisting of 4 wells and surface water intake. For surface water, the three contaminant categories where all non-community surface water intakes received a high susceptibility rating were inorganics, disinfection byproducts precursors and pathogens.

Water Sources and Quality: Rutgers- New Brunswick

At the Rutgers New Brunswick campus, the drinking water is managed by the New Brunswick Water Utility. The water quality (not just the campus but for the entire town) is approved by the EPA since the last testing from 2019 (even though there were some contaminants identified) with a passing grade. Further information regarding the water quality is provided in the water report. While there isn't too much information about this campus' water, it is known that the New Brunswick has a population of 56,100 and this water utility has around 7,500 active accounts. The exact number of people who use this water system in the campus area is unknown. Overall, so far the water quality is identified to be safe for drinking.

Greenhouse Gas Emissions of Bottled Water:

Data exists for the carbon footprint of a 1.5 L plastic soda bottle was found at Tapp Water (https://tappwater.co/us/carbon-footprint-bottled-water/) and is summarized in Table 3.1. The University of Wisconsin student work to explore the reduction of GHG emission in their student housing by substituting refill water bottles for single use water bottles. The student estimated that refilling the water bottle twice daily, washing it weekly, would reduce greenhouse gas emissions by about 200 kilograms CO_2e or about 450 pounds. (https://sustainability.wisc.edu/refillable-water-bottles-research-in-progress/)

Table 3B.2. Carbon Footprint of a 1.5 L plastic bottle (Source: https://tappwater.co/us/carbon-footprint-bottled-water)

Variable	Low	Medium	High
CO2 footprint per 50 oz (1.5 liter) bottle cradle-to-cradle	1.6 ounces (44 g)	9 ounces (250 g)	22 ounces (633 g)
CO2 footprint total bottled water	31 billion pounds (14 billion kg) CO2	176 billion pounds (80 billion kg) CO2	446 billion pounds (203 billion kg) CO2
Equivalent in distance driven by a car*	52 billion miles (84 billion km)	298 billion miles (480 billion km)	757 billion miles (1,218 billion km)
Equivalent in distance driven by a car*	5 million cars	29 million cars	74 million cars
% of total CO2 released globally per year***	0.038%	0.21%	0.54%

Based on bottling in the US

Study	CO2 footprint	CO2 footprint 1.5 l bottle	Notes
OI – PET	214 g per 355 ml	214 g x 4.2 x 70% = 633 g	Assumption that total footprint of a 1.5l is 70% less per 0.355 l = 4.2x
OI - Glass	171 g per 355 ml	171 g x 4.2 x 70% = 503 g	Same as above
OI – Aluminium	401 g per 355 ml	401 g x 4 = 1604 g	4 cans
OI - Glass refill	6 g	6 g x 4 = 24g	Assumes each bottle is reused 30 times

Greenhouse Gas Emissions: Traditional Plastic vs Bioplastic

Our group examined the differences in greenhouse gas emissions produced through different methods of water consumption. One such comparison was between traditional plastic (sourced from petroleum) and bioplastic (sourced from renewable materials, often plant matter). In a study conducted by the Journal of Cleaner Production, the greenhouse gas emissions produced by a traditional PET bottle were compared to those produced by a PLA bottle made from the starch of cassava plants, from the harvesting of the raw materials to the ultimate disposal of the bottle. The study found that overall, PET bottles produce more emissions and harm the environment more than PLA bottles. Other than the harvesting of the cassava starch for the PLA bottles, every other step in their production produced emissions in lower quantities than PET bottles. Because bioplastic is made from organic materials, their disposal is much "greener", as they can decompose more easily and will not exist in a landfill for hundreds of years like a PET bottle will. In short, bioplastics provide a greener alternative to traditional plastic, though the complete elimination of single-use plastic is still the best option. Traditional Plastic vs Bioplastic Graphs Here are some graphs illustrating the differences between three types of PLA bottles vs a traditional PET bottle in terms of fossil energy demand and human toxicity potential. PET bottles have a much higher toxicity to humans mainly because of the harmful emissions produced when compounds found in PET bottles are produced, including ethylene glycol and terephthalic acid. Similarly, PET bottles have a much higher fossil energy demand than PLA bottles because producing the resins found in PET bottles requires much more fossil energy.

Types of Bioplastics

To further touch upon bio plastics, there are different types of bioplastics in the making of water bottles. PHA bottles are bio-based and biodegradable. PHAs are produced by bacterial fermentation using bio-derived feedstocks, including waste, making it an alternative to fossil-derived plastics

- Unlike PLA bottles, PHA degrades quickly in all conditions. It can break down as little as 20days in soil, compost and marine sediment. Also, PHA is the only biomaterial that can biodegrade in waterways.
- PLA on the other hand, requires an industrial composter to break down, making the material less environmentally friendly.
- However the biosynthesis process of PHA bottles is complex and very expensive, thus there's a lower production of this material.
- Researchers are finding ways to produce PHA cheaper. A water brand called COVE is in the making. Instead of plastic, the bottle caps are made of naturally occurring PHA biopolymer. They produce zero toxic waste breaking down into CO2, water and organic waste.

Plastic/glass bottles vs. Tap water treatment

To compare the different types of water packaging and tap water treatments, we read a study from Spain where they compared the impacts of 3 different types of water treatments to tap water, water packaged in plastic bottles and water packaged in glass bottles. The 3 different water treatments were conventional water treatment, reverse osmosis at the treatment plant and reverse osmosis domestically. One of the findings of this study was that tap water impacts are between 10 to 717 times lower than bottled water, likely because of the materials and energy that it takes to produce bottled water. 90% of the impacts from bottled water is just from the packaging. Also, the study found that for a m3 of water, glass bottles require 154 kg materials while plastic bottles need slightly less at 130 kg. Tap water only needs 0.5 to 1.3 kg of materials. There is a similar trend with energy. Tap water only needs 2-3 MJ of energy per m3 while plastic bottles need 1000 MJ and glass bottles need 4900 MJ. Based on these trends, glass bottles are the worst environmentally followed by plastic bottles. Tap water, however, is much more sustainable. This study also mentions that environmental impacts of plastic bottles would be reduced by up to 230% if a third to all of plastic bottles were recycled in comparison to only 50%. This is because there would be lower energy and material needs. The study concludes that the best option is reverse osmosis domestically because it is both environmentally sustainable and has a favorable taste.

Hydration Stations Project

There are 230 units on the New Brunswick campus. We mapped each of these on Google maps with the year they were installed and the model. The bottom picture is a screenshot of the map that we created for New Brunswick. Rutgers uses 12 different models and each is meant to last about 10-20 years. These hydration stations are maintained by Rutgers facilities and filters are replaced regularly.

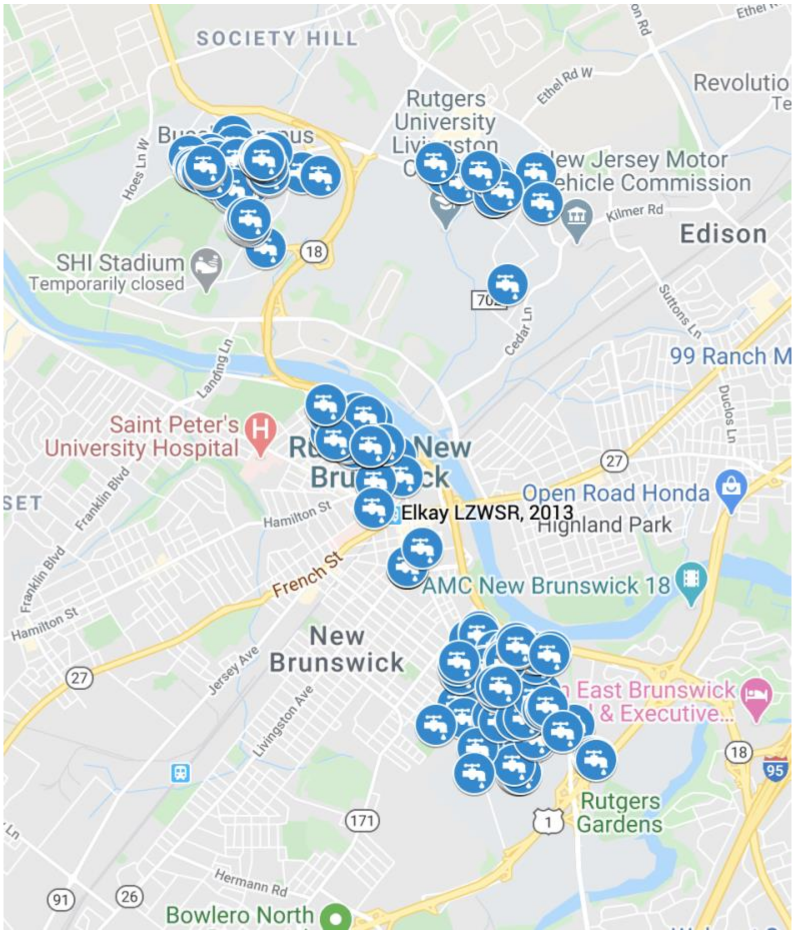


Figure 3B.1. 230 Water Hydration Stations mapped on Rutgers- NB.

Figure 3B.2. Example of a Water Hydration Station.

One of the biggest costs associated with the stations is changing the filters. They need to be replaced each year or after 3,000 gallons. Since each filter is about $50, these costs can add up. Also, the water from these stations is chilled, so refrigeration is another cost and it can use a lot of energy. At the moment, we don’t know exactly how much energy refrigeration uses or the cost. In terms of paying for these stations, facilities pay for the common areas while in residence halls, the occupants pay.

The Climate Survey also captured some concerns over the health and safety of using refill stations. The cleanliness and frequency of filters were mentioned as reasons why people do not use water refill stations.

Carbon Footprint of Tap Water vs. Bottled Water

Production Carbon footprint is simply a defined value for the amount of emissions caused by a product, company, or a person. It gives a quantified value for the amount of impact something can have on the environment. So, the carbon footprint of bottled water is obtained by studying all the various emissions from every stage of the production of a plastic bottle (the production includes filling, packaging, storing, and transportation). Many times bottled water is transported overstates and even over countries and therefore contributes a whole lot to the overall carbon footprint of bottled water. For example, Fuji water is an plastic bottle company that transports their bottles over countries and so due to the transportation of large distances, its carbon footprint would be larger and more impactful to the environment. Additionally, the disposal of these plastic bottles can also be huge contributors to the carbon footprint. On the other hand, the carbon footprint of tap water is obtained by considering the process of pumping ground or surface water, [process of] treatment of the water and [process of] pumping the water through pipes to reach the

consumer. Since, the process of production and transportation of bottled water is more intense (for just a single use bottle), it has a larger impact on the environment with
a much larger carbon footprint…and "studies….water'". One in 300 or one in 1000 Therefore, when comparing the two, tap water is the better choice of the two as it is the more environmentally friendly choice. A great alternative to single use plastic water bottles are refillable bottles which have a less impact on the environment and last longer than plastic bottles. Moreover, the usage of bottled only keeps increasing and so is the carbon footprint. People should be aware of the impact their plastic bottles usage have on the environment. As the usage of these plastic bottles increase, the damage that they have on the environment will only increase, too.

Comparing the Carbon Footprint of Bottled Water

Here are some statistics that compare the carbon footprint of bottled water and material, PET, toother carbon footprints. The first chart on the left compares the carbon footprint of PET material (used to make bottled water) to other materials. As you can see in the chart, the amount of material required for 1 PET bottle is more than glass or glass refill. Although aluminum has larger numbers, you have to consider that the usage of PET bottles exceeds that of aluminum cans. The second chart compares the carbon footprint of bottled water to cars and total global carbon footprint. The chart shows that a total carbon footprint of bottled water is equal to billions of miles travelled by cars. By considering these large impacts that bottled water has on the environment, the importance to switch to decrease our usage of plastic bottled water and move to tap water increases dramatically. Carbon emissions of aluminum cans vs. plastic bottle.

APENDIX C – Vending Machines and Hydration Stations Maps

Based on data obtained from Rutgers procurement, additional maps of Rutgers food systems were created. These include the locations of snack vending machines and hydration stations (Fig 3A.3). Marker colors represent different kinds of vending machines and their energy or LED bulb usage with orange and read designating Energy Star rated machines. These maps also include information about their sustainability features, such as LED lighting and energy star ratings, where available[63]. Maps for beverage vending machines at the New Brunswick campus have also been made but are not shown here. Data for locations of snack and beverage vending machines in Camden and Newark have not been obtained from Compass Group USA, LLC.

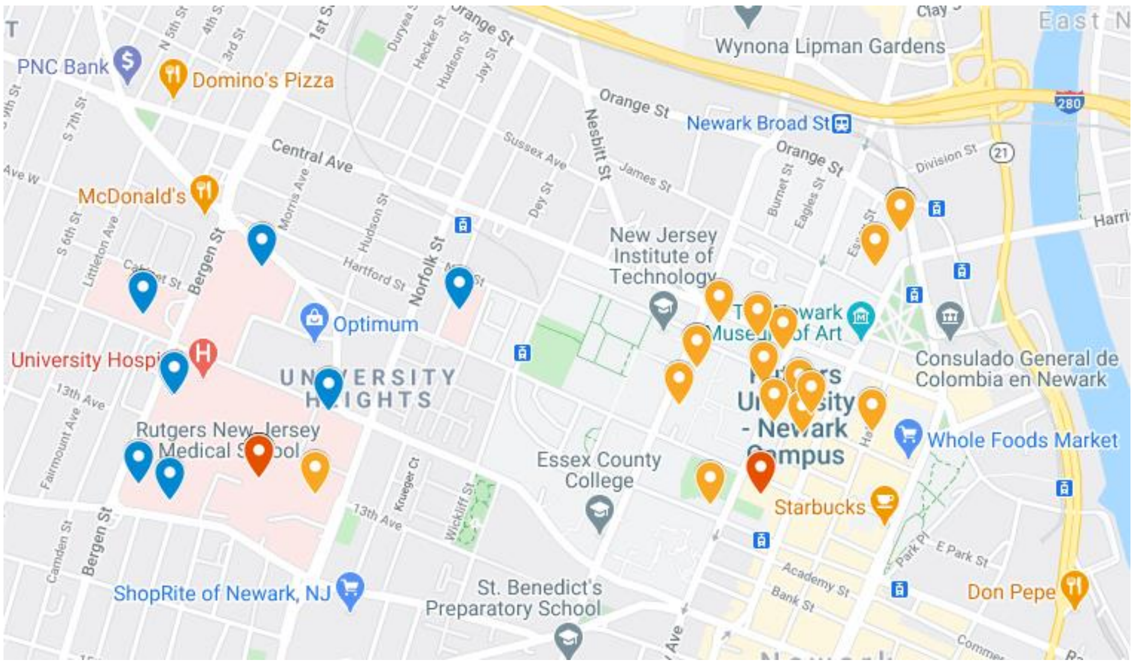


Figure 3C.1. Snack Vending Machines Map for Rutgers (Version 1.0) – Newark

[63] These maps will be posted at a later date on the Rutgers sustainability website.

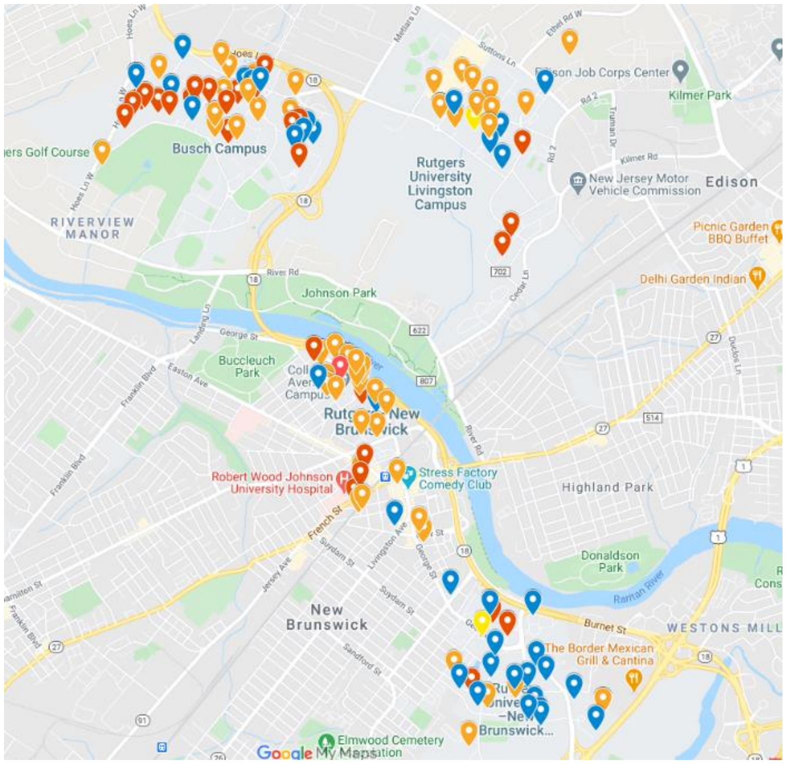


Figure 3C.2. Hydration Stations Map - Rutgers- NB

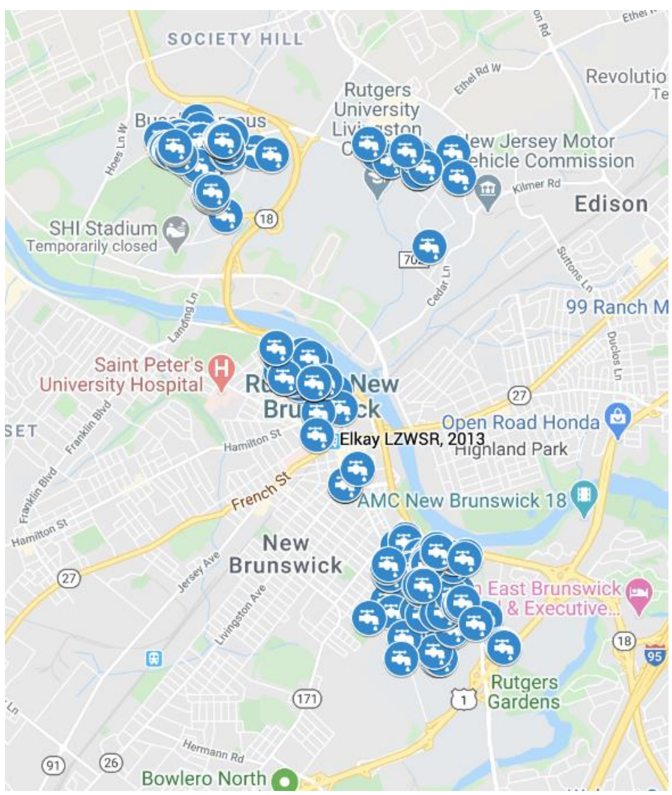


Figure 3C.3. Snack vending Machines Map - Rutgers- NB