STRATEGY FOR TRACKING AND REDUCING SCOPE 3 FREIGHT EMISSIONS

COLUMBIA UNIVERSITY
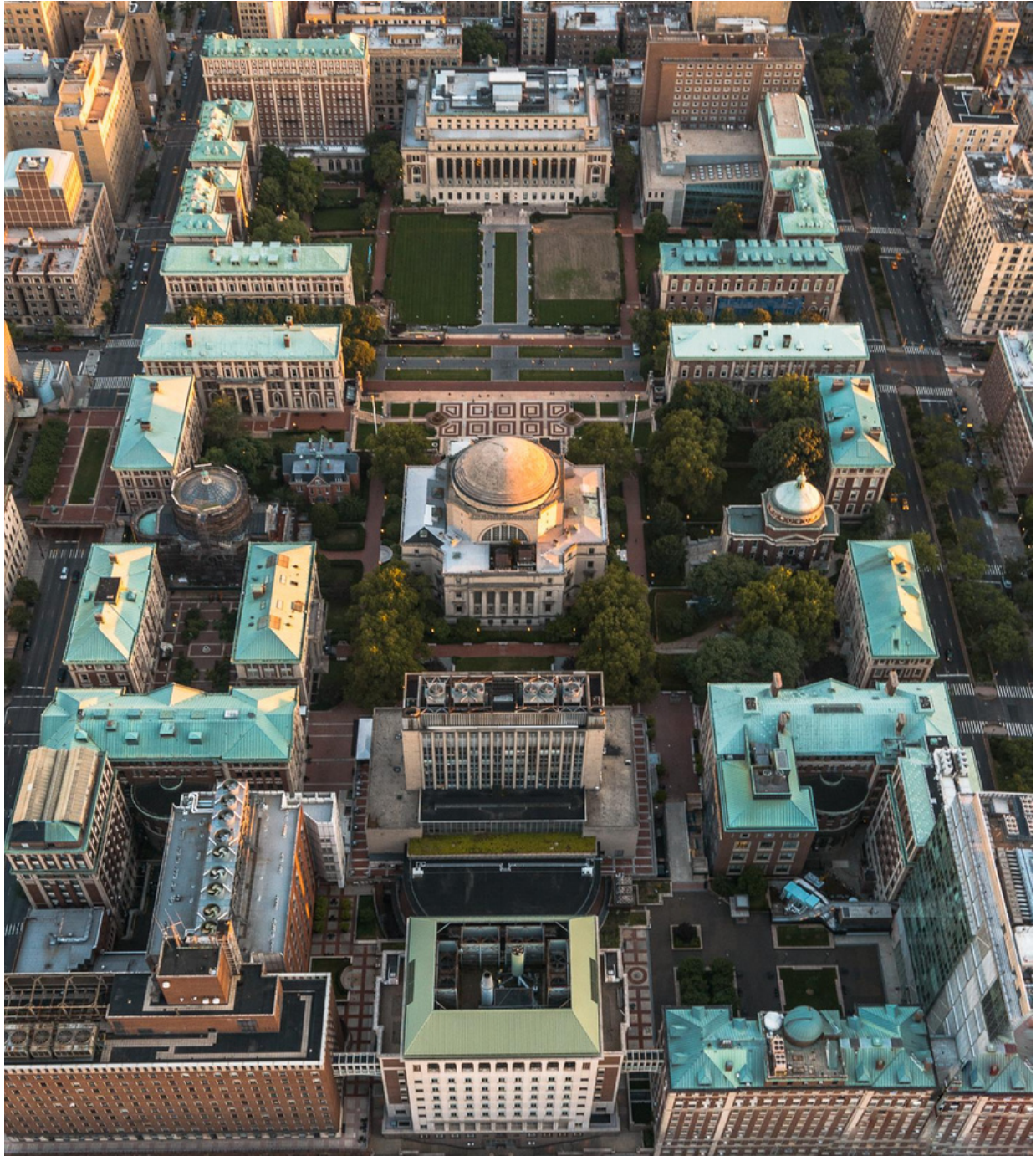
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ACKNOWLEDGEMENTS

ACRONYMS

CAGR: Compound Annual Growth Rate

CO2e: Carbon Dioxide equivalent

CU: Columbia University

CUIMC: Columbia University Irving Medical Center

EEIO: Environmentally Extended Input Output

EV: Electric Vehicle

GHG: Greenhouse Gas

GLEC: Global Logistics Emissions Council

NGO: Non-Governmental Organization

NYCDOT: New York City Department of Transportation

NYCEDC: New York City Economic Development Corporation

OES: Office of Environmental Stewardship

SBT: Science Based Target

SBTi: Science Based Targets Initiative

SIMAP: Sustainability Indicator Management and Analysis Platform

TCR: The Climate Registry

TTW: Tank-to-Wheel

US EPA: The United States Environmental Protection Agency

WBCSD: World Business Council for Sustainable Development

WRI: World Resources Institute

WTT: Well-to-Tank

WTW: Well-to-Wheel

GLOSSARY

Baseline: The time period that emissions may be tracked and measured against.

Carbon Dioxide Equivalent (CO2e): The number of metric tons of CO2 emissions with the same global warming potential as one metric ton of another greenhouse gas

Data Docks: Shipment monitoring and optimization software currently employed by Columbia University Manhattanville Loading Dock.

Emissions Factor: A representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant[1].

Greenhouse Gas: There are seven main greenhouse gasses as defined by the Kyoto Protocol that contribute to global warming.

Intermodal Shipping: Moving freight by two or more modes of transportation.

Ivy Plus Sustainability Consortium: Convened in 2007. Made up of sustainability experts from the Ivy League universities committed to best-practice sharing and ongoing exchange of campus sustainability solutions common to all campuses.

Last Mile Delivery: Last mile is characterized by the geographical segment of delivery between a distribution center (example: USPS warehouse) to the final delivery location (example: Columbia University campus). The final leg of a shipment.

Plan 2030: Plan 2030 is a ten-year strategic plan that outlines aggressive sustainability goals, grounded in climate science, for Columbia's New York campuses to achieve net zero emissions by 2050.

Scope 1 Emissions: Direct greenhouse (GHG) emissions that occur from sources that are controlled or owned by an organization[2].
Scope 2 Emissions: Indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling[3].
Scope 3 Emissions: Indirect emissions that the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain[4].

Science Based Targets Initiative: Globally recognized initiative for time bound emissions reductions goals inline with the UNFCCC and COP 21 Paris Accord.

SC Logic: Tracking software currently employed by Columbia University used to track incoming packages in the mailroom.

Tier 1 Supplier: Partners that an organization does business with directly.

EXECUTIVE SUMMARY

Columbia University (CU)'s ten-year sustainability plan, Plan 2030, identifies freight Greenhouse Gas (GHG) emissions as a significant opportunity for emissions reduction in achieving its sustainability goals, including net zero by 2050. To support CU in reaching these goals, the Office of Environmental Stewardship (OES) tasked Master of Science candidates in the Sustainability Management program with recommending strategies for tracking, reporting, and reducing Scope 3 emissions related to freight transportation.

The team conducted interviews with peer universities and corporations to understand how they approached tracking, reducing, and reporting their freight emissions. The team learned that CU is among few leading universities addressing Scope 3 emissions from this perspective. Based on this research, the team recommends **15 strategies to track, report and reduce** GHG emissions from freight transportation activity for completion by 2030:

1. Adjust Vendor Minimum Spend
2. Work With Vendors to Consolidate Deliveries
3. Centralize Purchasing Control
4. Greening Contracts
5. Revise Vendor Contracts to Require Data Sharing of Fleet Transportation
6. Designate and Enforce Specific Delivery Zones for CU Campus
7. Expand Administrative Mail Operations
8. Maximize Existing Mail and Delivery Tracking Technologies
9. Training Workshops for Operations Staff
10. Educational Workshops for Administrative Staff
11. Partner with Student Sustainability Organizations
12. Leverage Existing Communications Channels with Students
13. Calculate Last Mile Emissions for All Vendor Transportation Using the Vendor Last Mile Transportation Emissions Calculations Framework
14. Continue to Use The Climate Registry as a Reporting Mechanism
15. Continue Communication with Other Leaders in the Higher Education/Sustainability Space

The team also addressed the need to quantify vendor freight emissions for accurate tracking and goal-setting. Based on calculation methods outlined in GHG Protocol Category 4: Transportation and Distribution[5], and the Global Logistics Emissions Council's (GLEC) framework[6], the team created a flexible Vendor Last Mile Transportation Emissions Calculations Framework to guide CU in calculating freight emissions based on available data (e.g.: fuel data, spend data, distance traveled and weight) for vendor deliveries. To provide examples of how to use this tool, the team assessed two case studies: Mail Delivery Services and Staples Inc. The calculation guide will serve as a tool for the Office of Environmental Stewardship for quantification of emissions for other vendors in the future.

Reducing Scope 3 emissions requires collaboration with various internal stakeholders including finance and operations managers and department leads across all CU campuses. The Office of Environmental Stewardship should also work with external stakeholders including external vendors, local communities, and the City of New York to introduce efficiencies in freight deliveries with the ultimate goal of reducing GHG emissions, air pollution, congestion, and improving safety.

As a leader in the climate space, CU is uniquely positioned to define what it means to be a leader in sustainability. By implementing these recommendations, CU will position itself at the forefront of Scope 3 university emissions tracking efforts.

INTRODUCTION

Located in New York City at the forefront of higher education, Columbia University (CU) is a leader in climate science and sustainability. With twenty schools, a yearly enrollment of over 30,000 students, and five campuses across New York City, the university can lead by example in tracking, reporting, and reducing carbon emissions.

CU's Plan 2030 laid the foundation for this work, calling for absolute emissions reductions of 42% by 2030 and net zero by 2050, set against a 2019 baseline. The university currently reports Scope 1, 2, and select Scope 3 emissions categories to The Climate Registry (TCR), a non-profit emissions database specific to North America; specific Scope 3 value-chain categories include: business travel, commuting, and waste from operations as defined by GHG Protocol[7]. The university is therefore committed to expanding Scope 3 reporting, which includes inbound and outbound freight transportation. Plan 2030 specifically sets a goal to develop tracking and reporting methodologies for Scope 3 freight by 2025[8].

The university, with its immense size and a growing population of students, faculty, and staff, receives hundreds of deliveries weekly. These are essential to university functions such as dining services, office and laboratory supplies, and waste management. However, CU must consider the impacts of freight not only with regard to its carbon footprint and air pollution, but also as it relates to local traffic and transportation issues in New York City, including congestion and road safety.

The Office of Environmental Stewardship has made significant strides in assessing CU's carbon footprint. The following report offers insight into how to expand its current scope of work to include freight emissions and ultimately reduce emissions, contributing to the university's Plan 2030.

PROBLEM STATEMENT

Transportation using petroleum-based fuels such as gasoline and diesel accounted for the largest portion of greenhouse gas emissions in the United States at 27% in 2020[9][10]. Light-duty vehicles accounted for 57% of GHG emissions from transportation in 2020 followed by medium and heavy duty trucks contributing 26%[11].
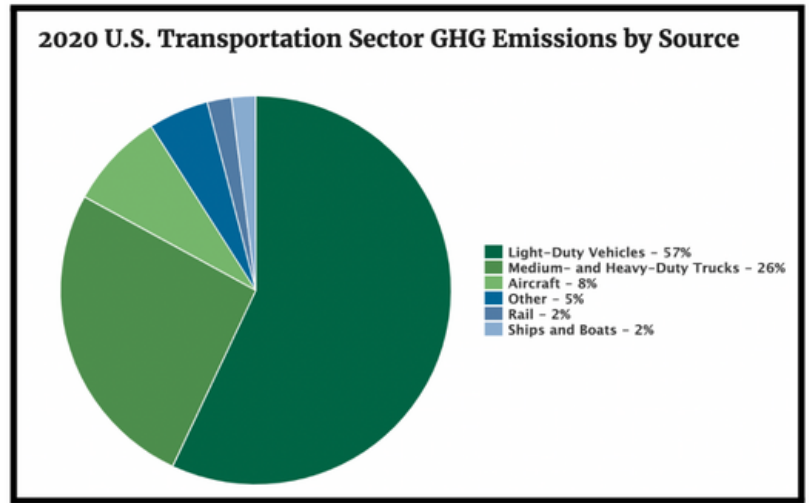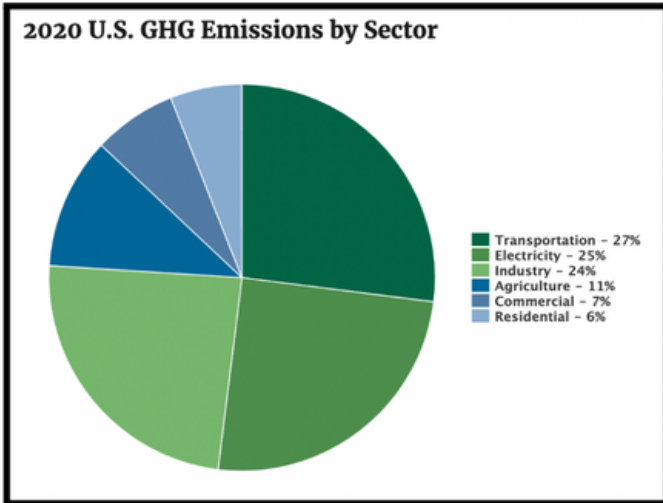
Figure 1 (left) and Figure 2 (right). US GHG emissions for 2020 by category (Figure 1) and a breakdown of transportation-related emissions (Figure 2), according to the EPA.

In the United States, New York City is a central hub for freight transportation. According to FreightNYC published by the New York City Economic Development Corporation (NYCEDC), the city's logistics network is vast; it includes 90 miles of rail lines, 1,300 miles of truck routes, and three marine terminals in addition to millions of square feet in warehouse space dedicated to storage and distribution[12]. While "freight" also includes rail, maritime, and air transport, NYC is most reliant on road freight. Nearly 90% of freight around the city is transported by trucks[13]. Trucks, specifically, contribute 11% of NYC's transportation-related emissions, which is 3% of the city's overall GHG footprint.

City agencies, including the New York City Department of Transportation (NYCDOT) and NYCEDC are developing ways to reduce the number of trucks on the road and find alternatives for freight transport in NYC. One initiative, the Blue Highways program, promotes the use of the city's marine facilities for freight transportation[14]. City agencies cite that waterways will make the last mile delivery more efficient by reducing truck traffic[15]. Other city initiatives include the implementation of Neighborhood Loading Zones and Off-Hours Deliveries programs to reduce truck idling and ensure trucks are not disturbing the flow of traffic; incentives for switching to low-emissions trucks such as the NYC Clean Trucks Program and the Green Loading Zones initiative; and the establishment of

micro-distribution centers to reduce or eliminate the emissions impact from last-mile deliveries by encouraging the use of alternative fuel vehicles or e-cargo bikes[16].

Efforts to reduce road freight and therefore reduce greenhouse gas emissions have the co-benefits of addressing other health and safety issues in NYC including road safety, congestion, and air pollution. According to NYC Crash Mapper, trucks were involved in over 3,400 vehicle crashes in NYC from July 2021 through June 2022. While there is limited data on the causes of the accidents, it is clear that heavy duty trucks given their size and driver visibility constraints pose a risk for other motorists, pedestrians, and cyclists[17].

With regard to congestion, a 2021 study named NYC the most congested city in the United States and the fifth most congested city in the world, with an average of 102 lost hours per driver due to traffic. These lost hours are estimated to cost each driver over $1,500 per year[18]. Reducing road freight can reduce extreme congestion.

Lastly, diesel trucks contribute significantly to air pollution from fine particulate matter or PM2.5. According to a 2022 study, heavy-duty diesel trucks contribute 52% of the city's PM2.5 emissions, although they only account for 6% of vehicles on the road. PM2.5 is known to adversely impact human health, causing respiratory issues such as asthma and other lung diseases. In NYC, specifically, Black and Brown residents are exposed to 17% more PM2.5 from diesel emissions than non-Hispanic or Latino, white residents[19].

Implementing innovative strategies to reduce the number of trucks on the road and, in turn, reduce freight emissions, would alleviate the impacts of these city-wide issues as well.

PROJECT GOALS

The three main goals of this Capstone workshop are to track "last mile" deliveries across the University system and campuses, expand Scope 3 category reporting through The Climate Registry, and develop strategies for emissions reductions related to freight transportation.

The tracking method proposed in this report will highlight potential opportunities for collaboration with vendors, freight carriers, city leaders, and other universities. Understanding and reporting freight emissions will inform key GHG reductions strategies between CU and its vendors and within CU's own operations. Lastly, achieving these goals will further define CU as a leader in university sustainability strategy and enable knowledge-sharing across various platforms such as the Ivy Plus Sustainability Consortium.

PROJECT APPROACH

The research team needed to first understand the landscape of freight emissions tracking across the industry before tackling specific calculations. For the purposes of this project, the team used the GHG Protocol's definition of freight: "transportation and distribution of products purchased in the reporting year, between a company's tier 1 suppliers and its own operations in vehicles not owned or operated by the reporting company"[20].

After reviewing university and corporation sustainability initiatives, the team developed a comprehensive interview protocol aimed at gathering specific data on how each institution tracks Scope 3 emissions, how they consider tracking freight in these plans, and insights into industry best practices for emissions calculations.

The team identified thirteen universities comparable to CU based on key criteria. Universities of interest were preferably in urban settings; were mid-to-large sized research institutions with extensive procurement needs; had already made significant progress in reporting Scope 1 and 2 emissions; and were either already tracking or planning to track and work to reduce Scope 3 emissions. Out of the thirteen universities originally identified, the team interviewed nine.

The team also identified eight corporations that were either New York City-based or global companies that had a strong NYC presence. Interview criteria included corporations that: had incentives in place in order to report and reduce their Scope 3 emissions; had extensive shipping and logistics needs; and were preferably reporting freight emissions data as part of their corporate social responsibility plan. Of the eight corporations, the team interviewed three and conducted literature research on the remaining five.

University and corporation interview questions are included in Appendix A. These interviews informed further conversations with CU operations personnel. The team gathered data from the Morningside mailroom, which receives both student and administrative mail via USPS as well as deliveries from other carriers such as UPS, Fedex, and Amazon.

The team also worked with representatives from Staples Inc., a key CU vendor, to understand delivery processes to CU campuses. Lastly, the team visited and interviewed employees at the Manhattanville Loading Dock, the newest loading dock at CU, to learn its operations and organizational processes in receiving freight deliveries (Appendix B). These three areas serve as the basis for the project's case study research in which the team completed emissions calculations for USPS and Staples.

With the context of CU operations in mind, the team contacted city leaders in the freight planning space. The goal was to learn of opportunities to join existing efforts at the city level to reduce impacts of freight deliveries, which includes reduced GHG emissions in addition to distinct co-benefits of reduced congestion, air pollution, and morbidity and mortality due to traffic incidents.

The above research informed the development of an action plan, which consists of 15 recommendations for tracking, reporting, and reducing CU's Scope 3 freight emissions. The recommendations strategy includes emissions reductions interventions the client should pursue to target inefficiencies, optimize current processes, and ultimately contribute to the university's Plan 2030 reduction efforts.

To inform the methodology for emissions calculations, the team first compared six standards and methodologies for inventory calculations that, according to literature research, had the strongest adoption in quantifying emissions for the transportation sector. Of the six frameworks, the team identified two best-fit methodologies, the Greenhouse Gas Protocol and the Global Logistics Emissions Council (GLEC) Framework, which are most applicable to this project and were widely recommended by universities and corporations[21]. These two methods are also recommended by The Climate Registry[22]. The team used these two methods along with supplemental resources from the US EPA and SmartWay program to generate an emissions calculation guide.

The Vendor Last Mile Transportation Emissions Calculations Framework is aligned with industry best practices for transportation emissions inventories. Using the GHG Protocol's Scope 3 Category 4 guidance as reference, the team created a data-dependent calculation approach to begin tracking the carbon footprint for CU's last mile deliveries. OES can replicate this process to track emissions from any CU supplier. The team completed two emissions inventories for USPS and Staples and offers recommendations for reducing emissions from these vendors, specifically.

ACTION PLAN

The team compiled a set of **fifteen recommended actions** Columbia should take to further track, report and reduce last mile freight emissions. The recommendations are broadly categorized by the type of action: Procurement Practices, CU Operations, CU Community Behavior and Office of Environmental Stewardship Activities.

Goals key for recommendations:

Track Emissions | **Report Emissions** | **Reduce Emissions**

PROCUREMENT PRACTICES

CU purchasing and procurement practices directly impact the volume of freight delivered to campus and contribute to the university's Scope 3 emissions. Recommendations 1-5 offer opportunities to alter procurement practices within CU administration to ultimately consolidate deliveries and reduce the number of freight trips to campus.

RECOMMENDATION #1:

ADJUST VENDOR MINIMUM SPEND (2023-2024)

REDUCE EMISSIONS

Minimum order spend prevents disorganized and superfluous procurement practices. When implemented correctly, increasing minimum order spend allows for more efficient and streamlined delivery systems. For example, when ordering supplies from Staples Inc., office managers at CU must meet a minimum order requirement of $35. On average, this amount equates to two items. Raising the minimum spend threshold would incentivize better planning for purchases and order bundling and may consequently reduce the number of deliveries. This would ultimately reduce GHG emissions stemming from freight transportation.

OES should pilot this initiative with one or two departments to determine what thresholds are appropriate for a given vendor. For example, by looking at historical spend data between CU Campus Services and Staples, OES can set the new threshold for an average order spend value. Staples can then help CU with understanding their environmental impact of purchases through their "Small Orders Calculator - Environmental Impact Report" (Figure 3), which analyzes purchasing data and offers estimates of CO_2 emissions before and after changing the minimum spend threshold. The Office of Environmental Stewardship should communicate with other vendors to determine if they have similar programs to model the environmental impacts of orders.

Small Order Calculator - Environmental impact

Current Customer Statistics				
Customer:	Example Customer			
Account #:	1234567ABC			
Analysis Period:	01/01/21 - 06/30/21			

Order values	# Orders	Spend USD	% of Orders	% of Spend
<$10	8	$18	0.1%	0.0%
$10 to $24.99	89	$259	1.4%	0.0%
$25 to $34.99	265	$436	4.1%	0.0%
$35 to $49.99	638	$733	9.9%	0.0%
$50 to $74.99	924	$56,584	14.4%	3.5%
$75 to $99.99	529	$45,987	8.2%	2.9%
$99.99 to $149.99	912	$112,758	14.2%	7.1%
$150 to $199.99	677	$117,360	10.5%	7.3%
$200 to $249.99	492	$110,282	7.6%	6.9%
$250 to $499.99	1,194	$417,566	18.5%	26.1%
$500+	711	$737,298	11.0%	46.1%
Total	**6,439**	**$1,599,280**	**100.0%**	**100.0%**

Environmental burden		Average per order	Current consumption	Annual consumption
Transport	miles driven	1.96	12,620	25,241
	gallons of fuel (per mile)	0.12	1,502	3,005
	lbs CO_2 emissions (per mile)	2.64	33,354	66,708
Packaging	Lbs of corrugated boxes	2.59	16,693	33,386
	Lbs of pulp (packing slips)	0.02	129	258
	Lbs of air pillows	0.0083	53.2	106.4
	Lbs of solid waste	1.457	9,380	18,759
Use of resources	# of equivalent trees	0.0203	131	261
	kWh of Net Energy	10.74	69,185	138,370
	gallons of Water Consumed	18.31	117,900	235,800

Possible Annual Benefits and Savings			
Analysis assumes that all orders below the proposed minimum order value would be combined with existing orders that are larger than the min. order value			
Proposed Minimum Order Value:	50	# Orders to be combined:	1,000
Scenarios :	Current	After analysis	Savings
Average order value	$248	$294	18.4%
Lbs CO_2 emissions	66,708	56,348	10,360
# of trees	261	221	41
kWh of Net Energy	138,370	116,881	21,489
Gallons of Water	235,800	199,179	36,621

Kg CO_2 emissions - per year

# of trees - per year

Figure 3. Example of Staples Inc. Small Orders Calculator - Environmental Impact Report.

Immediate Next Steps: The team recommends that OES begins by collaborating with CU procurement offices to ascertain which vendors and goods categories might be the most appropriate to pilot this initiative. At the same time, OES should begin working with Staples to assess CU's Environmental Impact Report and set new minimum order thresholds by department or uniformly across the university, depending on the results of the report.

PROCUREMENT PRACTICES

RECOMMENDATION #2:

WORK WITH VENDORS TO CONSOLIDATE DELIVERIES (2023-2024)

REDUCE EMISSIONS

CU can collaborate directly with vendors to pursue the joint achievement of each party's sustainability goals. For example, if CU orders were consolidated, vendors would be required to make fewer deliveries. This would result in a Scope 1 emissions reduction and cost saving for the vendor (e.g. reduction in fuel and maintenance of vehicles), and a Scope 3 emissions reduction for CU. OES can work with CU procurement and top vendors, such as those that frequently deliver generic products that are purchased in high volumes, to analyze historic purchasing data and determine which and how orders could be consolidated.

For example, CU can reach agreements with vendors on the flexibility and timing of deliveries. When it is appropriate, instead of processing and delivering orders immediately, vendors could wait 1-2 days to facilitate order consolidation. In the case of Staples Inc., office supplies are often delivered the next day and sometimes deliveries only contain a small number of items. Staples' "Small Orders Calculator Environmental Impact Report" can calculate the estimated emissions reductions from consolidated deliveries.

Immediate Next Steps: Staples Inc has already expressed interest in working with CU to produce a tailored Environmental Impact Report to identify ways to consolidate orders and develop an emissions reduction plan.

PROCUREMENT PRACTICES

RECOMMENDATION #3:

CENTRALIZE PURCHASING CONTROL (2023-2024)

REDUCE EMISSIONS

Four of the nine universities interviewed described heavily decentralized purchasing practices as a major barrier to the tracking and reduction of freight emissions on their respective campuses. CU faces the same problem. While staff in the Procurement and Contracts department handle all large or major purchases, purchases of everyday office essentials, for example, are often made by the many sub-departments or individual offices across the university. With so many employees authorized to order from CU approved vendors, multiple deliveries, often of the same or similar goods, are made to the university on a daily basis. Staples Inc. reports that over 1,000 CU faculty and staff have the ability to make direct purchases from them. Such orders often include generic supplies such as printing paper and pens — purchases that can easily be consolidated to reduce the number of deliveries per week. Order consolidation would reduce the number of vehicle miles traveled by freight delivery trucks, reducing CU's Scope 3 freight emissions.

The team recommends that, where appropriate, the university **centralize purchasing control** to streamline common orders and deliveries.

Individual office procurement requests for generic items such as office supplies, paper products, cleaning supplies, and disposable products can be managed through centralized purchasing.

One department per campus or per school, for example, should oversee and greenlight all individual purchase requests, to ensure that orders occur on a less frequent, but regular basis. Oversight by a single authority may provide opportunities to combine departmental purchases under a single vendor and ultimately consolidate deliveries.

Immediate Next Steps: With the assistance of the Procurement offices across campuses, the OES should analyze order data from major vendors to identify the most common goods purchased and where centralization of orders would be most efficient. At the same time, OES should research software applications that can be used to streamline purchase requests across departments.

PROCUREMENT PRACTICES

RECOMMENDATION #4:

GREENING CONTRACTS
(2023-2025)

GHG emissions associated with freight transportation across the supply chain are directly linked to both purchase and vendor behavior. Vendor practices, specifically at the last mile, can have significant impacts on emissions, road safety and congestion. CU has the **purchasing power** to influence the behavior of the vendor. At the same time, the vendor will ideally prioritizes requests from its client.

The team learned that some universities have specific provisions within vendor contracts to reduce Scope 3 emissions. These contracts with vendors state the university's intent to reduce Scope 3 emissions with regard to purchased goods and services and related transportation and distribution. Some universities also require that vendors use reusable tote bags to deliver goods instead of one time use boxes to reduce packaging material.

CU should alter its request for proposals (RFPs) and contract renewal process to require that vendors implement changes to their transportation and delivery processes to reduce emissions and prioritize safety. CU could require that vendors report their

Scope 1 and 2 emissions related to freight transportation (CU's Scope 3 emissions). The university can also require vendors to have ambitious emissions reduction (or transition) plans in place that are science-based and aligned with the 1.5 degrees target as set by the Paris Agreement. The vendor should agree to provide the plan as well as progress made. To track progress, the university can require vendors to report their delivery data to an online platform every quarter. Vendors should also identify ongoing and future freight emissions reduction strategies.

PROCUREMENT PRACTICES

Other potential requests or requirements for the vendor (informed by university interviews and team brainstorms):

- Upgrade their vehicle fleet to include more fuel efficient vehicles, including but not limited to electric vehicles or vehicles that can utilize alternative fuels such as renewable diesel or biodiesel.
- Improve packaging to reduce package weight and increase capacity for packages in delivery vehicles thereby reducing the number of necessary delivery trips (e.g. use tote bags or less bulky packaging).
- Delivery vehicles that receive fines for traffic violations - e.g. parking in bike lanes - must pay them instead of agreeing on a settlement number to discourage this dangerous practice.

Immediate next steps: The Office of Environmental Stewardship should contact the various purchasing offices at Columbia University to identify top vendors, especially vendors whose contracts are set for renewal in the next year. Upon identifying these vendors, the office can put together a contract negotiation strategy to target specific vendor processes.

PROCUREMENT PRACTICES

RECOMMENDATION #5:

REVISE VENDOR CONTRACTS TO REQUIRE DATA SHARING OF FLEET TRANSPORTATION (2023-2024)

TRACK EMISSIONS

REDUCE EMISSIONS

To calculate Scope 3 GHG emissions from freight, vendors must provide data on distance traveled, cargo weight and/or fuel used. CU does not currently capture this data in a centralized location, which makes quantifying emissions challenging.

Several universities interviewed, including Duke University and Yale University, noted that data availability and data quality were the biggest challenges to collecting data required for completing a thorough Scope 3 emissions. The team recognizes that engagement with vendors and variance in data availability and consistency will be challenging to implement.

When releasing RFPs to vendors, CU can **require that vendors disclose their freight data** for the purpose of annual GHG measurement and tracking. Data should include the type of vehicle used for the trip, the fuel used and weight of the delivery. Vendors will be required to share this data for the duration of the contract. When renewing contracts with current vendors, CU should negotiate the inclusion of this data as well.

Immediate Next Steps: The Office of Environmental Stewardship should partner with CU purchasing offices to initiate a review of contracts that are expiring within the next year and develop language that requires vendors to provide data required for a Scope 3 GHG inventory. OES should consult with peer university sustainability leads to learn about best practices that can be applied to CU's RFP development process.

Limitations to "Procurement Practices" Recommendations:
While order consolidation and increasing the minimum spend will reduce freight emissions, there are roadblocks with implementing changes that will result in fewer deliveries to CU campuses. NYC buildings and office spaces are small and the lack of available space to store items in bulk poses a challenge for most buildings across the campus. Additionally, if minimum spend requirements are increased, there may be a tendency for users to order more products than necessary to meet the spend requirements.

CU OPERATIONS

The following two recommendations outline key operational changes that can help reduce CU Scope 3 freight emissions. These include opportunities to partner with various CU departments and other city stakeholders.

RECOMMENDATION #6

DESIGNATE AND ENFORCE SPECIFIC DELIVERY ZONES FOR CU CAMPUS *(2023-2024)*

TRACK EMISSIONS

REDUCE EMISSIONS

Morningside Heights mailroom employees have cited issues with delivery logistics and curbside congestion. Rather than pulling into the designated curbside parking spaces, delivery vans from UPS, FedEx, Amazon, and other couriers arriving at both the Student and Administrative Mailrooms often park in the traffic lane or bike lanes, leaving their engines idling. At both locations, delivery trucks routinely increase congestion on the block, and leave oncoming cars, pedestrians, and bikers in danger by blocking the main road and bike lanes.

In addition to emissions and air pollution from heavy trucks, road safety and congestion are of particular concern in New York City. Because CU campuses cover a wide geographic area, road and pedestrian safety in those areas should be a priority. For the mailrooms, in particular, CU should **enforce the use of existing delivery spaces** near the mailroom entrances.

This may require reallocating existing neighboring passenger vehicle parking spaces to the mailroom during daylight hours to make the mailroom delivery spaces larger.

CU OPERATIONS

CU should also work with the city, particularly the Department of Transportation (DOT), to increase safety measures. This might include the design of a Neighborhood Loading Zone (NLZ), which could be reserved for deliveries and drop-offs on a given block near common delivery locations, such as student dining halls. DOT has introduced NLZs in all five boroughs, including parts of the Upper West Side in Manhattan [23]. CU has the opportunity to continue this effort, which will not only mitigate idling and reduce emissions, but also improve neighborhood safety.

Immediate Next Steps: The team recommends that the Office of Environmental Stewardship work with CU operations managers to identify and remove barriers to expanding and enforcing the use of existing delivery spaces, zones and loading docks. The office should also contact the NYC Department of Transportation and the NYC Economic Development Corporation to assist with delivery parking enforcement where necessary and to initiate participation in programs such as NLZs if needed. Contact information will be provided to the OES.

RECOMMENDATION #7:

EXPAND ADMINISTRATIVE MAIL OPERATIONS
(2023-2025)

TRACK EMISSIONS

REDUCE EMISSIONS

While the Morningside Heights Student Mailroom receives all mail and packages from all courier services destined for the campus' undergraduate housing residents, its Administrative Mail counterpart only receives USPS and interdepartmental mail. Therefore, with no central delivery location available to them, administrative mail and packages coming via any other courier service are delivered in a less streamlined manner; individual packages are delivered to university buildings. Without the consolidation of trips, multiple deliveries are made to the university by the same courier services every day.

In an effort to reduce freight emissions by decreasing the number of deliveries made to the Morningside Heights campus every day, the team recommends that the Administrative Mailroom facilities and operations expand to match with those of the Student Mailroom. Specifically, the Administrative Mailroom should serve as a central delivery location for all administrative mail and packages from all courier companies destined for Columbia staff and faculty on Morningside campus. Unlike with the Student Mailroom, however, where students are required to collect their own mail, we recommend that the upgraded Administrative Mailroom services include the on-foot delivery of mail and packages to individual university buildings offices. This would ensure that the productivity of CU staff and researchers is not inhibited by these operational changes.

Immediate Next Steps: The team acknowledges that such a change would be a challenging undertaking. It would likely require the mailroom to significantly increase their staff and acquire much more space. To investigate this process further, it is recommended that the Office of Environmental Stewardship conduct a cost-benefit analysis of the proposed project.

RECOMMENDATION #8:

MAXIMIZE EXISTING MAIL AND DELIVERY TRACKING TECHNOLOGIES
(2023-2024)

TRACK EMISSIONS

REDUCE EMISSIONS

The Morningside Student Mailroom and the Manhattanville Loading Dock are utilizing mail and tracking technologies that assist them in managing CU deliveries. Both of these technologies, however, are siloed operations facilities and are thus not being utilized to their full potential.

The Student Mailroom uses a software called **SC Logic** to track all mail and packages that come through the facility. Beyond increasing internal mailroom organization and efficiency, SC Logic collects information about delivery frequencies and load size, and recipient data. This program is presently only being used in this particular mailroom to track mail destined for students living in Columbia's thirty undergraduate residence halls. No other mailrooms track and organize mail in this way.

The Manhattanville Loading Dock employs a cloud-based software solution called **DataDocks** which allows vendors to book delivery appointments in advance. The loading dock team then quantifies packages received and monitors loading and unloading times for each shipment. The loading dock currently only receives 60 deliveries a week, but deliveries are expected to increase with campus growth.

Employees are not capturing all the possible data from vendors that DataDocks has the capacity to collect, such as package weight and distance traveled, which would be beneficial for last mile delivery emissions tracking. As the campus grows, the loading dock will presumably get busier. Proper use of this system will be integral to alleviating many of the traffic congestion and street idling issues that are likely to arise without an organized delivery schedule, as well as to measuring the emissions impacts of the increased activity.

CU OPERATIONS

The team recommends that use of these software systems be upgraded and, where relevant, extended throughout the university:

- SC Logic should be installed in all Columbia mailrooms so that the university is able to create a centralized information hub of all incoming mail and package deliveries. This would ensure consistent data collection across mailrooms, allowing for greater insight into the university's purchasing and delivery behavior. This is particularly important as the number of 'boutique' deliveries increases, i.e. those made by couriers outside of the five mainstream companies delivering daily. SC Logic can help inform future emissions reduction strategies, such as those involving procurement practice adjustments and staff and student behavioral interventions.

- The Manhattanville Loading Dock should enforce and maximize the use of DataDocks now, to get a head start on the swift expansion of the campus.

- OES and relevant operations teams should remain in touch with the SC Logic & DataDocks sales teams to keep up-to-date with the softwares' capability improvements so that CU can continue to enhance its use of these technologies. In particular, CU should look out for future opportunities to use these technologies to acquire more accurate emissions tracking data such as package or load weights, or more specific last mile journey information.

Limitations to "CU Operations" Recommendations:

Infrastructural and operational changes may prove costly and time consuming in the short term. Staff will need to dedicate efforts to organizing meetings with NYC stakeholders and software developers. However, they are likely to leave the university better positioned to mitigate emissions over the long term as its campus activity grows.

CU COMMUNITY BEHAVIOR

Purchasing and operations changes alone are unlikely to produce tangible emissions reduction benefits unless they are accompanied by behavioral changes by faculty, staff and students across the university.

FACULTY AND STAFF

Faculty and staff engagement are critical for implementing sustainability initiatives. The following recommendations will ensure all CU stakeholders are fully informed and buy into operational changes across campus aimed at reducing Scope 3 freight emissions.

RECOMMENDATION #9:

TRAINING WORKSHOPS FOR OPERATIONS STAFF
(2023-2024)

TRACK EMISSIONS

REDUCE EMISSIONS

Annual or semi-annual **training sessions for operations staff**, including mailroom and loading dock employees, will help ensure all employees are aware of changes to operational processes as well as create a sense of ownership over the goals behind the changes. The outcomes of the interviews with the mailroom and Manhattanville Loading Dock indicated that employees are curious about how to address inefficiencies in their operations. They would be willing to participate in training specific to sustainability and freight operations.

Workshops should include training on expansion of existing freight tracking technologies already in use (such as SC Logic in mailrooms and DataDocks at the Manhattanville Loading Dock) and additional data collection processes. It would be helpful to provide context for any changes in processes such as relevant Plan 2030 goals and potential emissions reductions associated with such changes. These training sessions should be required for all operations managers, and encouraged for all operations employees regardless of position.

Immediate Next Steps: The Office of Environmental Stewardship should contact CU operations administrators to review current employee training and discuss needs and timeline for building out a curriculum for workshops.

CU COMMUNITY BEHAVIOR

RECOMMENDATION #10:

EDUCATIONAL WORKSHOPS FOR ADMINISTRATIVE STAFF
(2023-2024)

REDUCE EMISSIONS

Due to the decentralized nature of freight and purchasing, providing educational workshops to CU employees who are in charge of purchasing will strengthen buy-in for new procurement practices.

The team recommends initiating a two part **workshop training program** for the key stakeholders. The first training will revolve around a basic understanding of sustainability; how CU is addressing it; and where their departments fit into university goals. The second training will be specific to the stakeholder/department outlining new practices and processes, and why these changes would make a difference in reducing emissions.

With the introduction of changes to purchasing processes, educational workshops will ensure all CU administrators are equally informed about process changes. Administrators will learn the intention behind interventions such as consolidated deliveries, greening contracts, and changes in data collection from vendors. OES should facilitate these trainings through RASCAL, which is currently utilized by administrators for faculty and staff training. These workshops should be mandatory for all authorized purchasers at CU.

Immediate Next Steps: The Office of Environmental Stewardship should contact the purchasing department to establish the goals of this program and discuss the logistics of holding several workshop sessions to accommodate the schedules of all staff required to attend. Once all updates to the purchasing process are finalized, the office can begin to develop the curriculum for the workshops.

CU COMMUNITY BEHAVIOR

CU STUDENTS

Students make up a large portion of CU's population. As the number of purchases and deliveries grows with the student population, so will the university's emissions resulting from purchased goods and freight transportation. It is important for the university to encourage and incentivize students to adopt more sustainable consumption habits. Recommendations 11 and 12 outline two ways CU can engage students in meeting these goals.

RECOMMENDATION #11:

PARTNER WITH STUDENT SUSTAINABILITY ORGANIZATIONS (2023-2023)

REDUCE EMISSIONS

The team recommends that OES **collaborate with student-led sustainability initiatives** across CU. Efforts should include increasing the budget and visibility of sustainability-oriented clubs to elevate salient issues, such as consumption habits and their relation to freight transportation emissions.

At the beginning of every school year, incoming freshmen moving into the residence halls order new dorm room necessities: bedding, decor, and even larger appliances such as refrigerators. The delivery of all of these orders is what causes the "Fall Rush" for CU mailrooms. At the end of every year these "necessities" are left behind by outgoing seniors. Columbia University Facilities and Operations, together with various student partner organizations, have established "**Clean + Go Green**", a program that facilitates the collection of these goods, so that they may be reused, recycled or otherwise properly disposed of. We recommend that OES expand Clean + Go Green efforts to provide incoming students with the opportunity to purchase these secondhand dorm room necessities, to avoid having new items delivered to campus. This would ease some of the pressure on the student mailroom, and reduce both freight and embedded emissions of student mail and packages.

CU COMMUNITY BEHAVIOR

RECOMMENDATION #12:

LEVERAGE EXISTING COMMUNICATIONS CHANNELS WITH STUDENTS
(2023-2023)

REDUCE EMISSIONS

The Student Mailroom works closely with student housing coordinators to help ease Fall Rush congestion in the mailroom. On behalf of the mail team, Student Housing passes along instructions to incoming students on how and when to order dorm room and back to school supplies so that they are delivered before the start of the school year. OES can leverage and build upon these lines of communication to **educate incoming and existing students** about the environmental impacts of increased consumption, and inform them of the efforts the university is taking to reduce these impacts, and the ways in which students themselves might assist in these endeavors.

The team recommends that the Office of Environmental Stewardship utilize the student-facing position that student housing administrators hold to inform incoming students about, and incentivize their uptake of, the university's secondhand program well in advance of Fall Rush. Such initiatives would not only directly help reduce freight and embedded emissions from new purchases, but it would also establish an awareness of and an appreciation for the university's growing sustainability priorities and culture. This would, in turn, leave students primed to participate in future sustainability efforts that impact freight emissions, like providing more local and seasonal food options, or reducing the number of mail delivery days per week.

Limitations to "Behavior Change" Recommendations:

The behavior change necessary for changing procurement practices that are deeply embedded in the University's culture could be met with resistance by faculty and staff. It takes time to educate faculty and students on the benefits of changing purchasing practices and realize the benefits.

OFFICE OF ENVIRONMENTAL STEWARDSHIP ACTIVITIES

There is much more work to be done to fully assess Scope 3 freight emissions associated with Columbia. Recommendations 13, 14, and 15 serve as a guide to calculating and reporting additional Scope 3 emissions while, at the same time, maintaining communications with other leaders in this space across NYC and in partnership with other university affiliates.

RECOMMENDATION #13:

CALCULATE LAST MILE EMISSIONS FOR ALL VENDOR TRANSPORTATION USING THE VENDOR LAST MILE TRANSPORTATION EMISSIONS CALCULATIONS FRAMEWORK (2023-2030)

TRACK EMISSIONS

REPORT EMISSIONS

Calculating the greenhouse gas emissions associated with CU's freight-related transportation in Scope 3 is an essential step to reaching Plan 2030 goals. There are several frameworks and protocols that provide guidance for estimating GHG emissions for Scope 1, 2 and 3 emissions. To determine the best method for GHG accounting in the context of freight transportation, the team interviewed nine universities, three corporations, and researched city and state policies.

After conducting desktop and interview-based research on these calculation methodologies, the team recommends the use of two methodologies:

(1) the Greenhouse Gas (GHG) Protocol which includes:
- Supplemental: Corporate value chain (Scope 3) Standard
- Supplemental: Technical Guidance for Calculating Scope 3 emissions
- Supplemental: Category 4: Upstream Transportation and Distribution

AND

(2) the Global Logistics Emissions Council (GLEC)'s Framework

OFFICE OF ENVIRONMENTAL STEWARDSHIP ACTIVITIES

The GHG Protocol provides step-by-step instructions for organizations to define their Scope 3 activities, understand their reporting boundary, and collect carbon accounting data[24]. The GHG Protocol does not specifically provide guidance on transportation logistics. However, the GLEC framework is specifically tailored to shippers and logistics providers to measure CO2e from freight emissions[25].

According to the interviews conducted, universities and corporations primarily use the GHG Protocol and supplemental guidance from the EPA Smartway program and the EPA Emission Factors Hub to guide Scope 3 emissions tracking. MIT FreightLab mentioned that the MIT Center for Transportation and Logistics has explored the use of the GLEC framework.

Based on this research, the team developed a customized guide to help the university through the calculation process (Appendix C). It is recommended that the Office of Environmental Stewardship consult the Vendor Last Mile Transportation Emissions Calculations Framework to calculate emissions associated with external vendor activities. The framework can be used for any external vendor.

The framework guides the calculation of tank-to-wheel (the fuel combustion stage when the fuel is in use by the vehicle), last-mile vendor transportation as defined by GHG Protocol[26]. This is included in Scope 3: Category 4.

The team recommends starting with the fuel-based calculation method and using the GHG Protocol. This method requires fuel consumption data, including primary fuel consumption or distance-traveled and vehicle efficiency data. This approach is likely the most common calculation method.

If the Office of Environmental Stewardship implements an initiative for expanded data collection, they can also use the GLEC methodology to calculate emissions with maritime, air, and rail freight transportation. The GLEC Framework guides the user on distance-based calculations using distance and mass data (from the vendor) and GLEC's emissions factors. It is noteworthy to state that this data can be difficult to obtain [27]. For example, the delivery and mail software currently in use at CU does not require weight inputs, and vendors are unlikely to provide detailed route and weight or volume data per trip.

GLEC framework is the most common industry standard to report logistics emissions over the global multimodal supply chain therefore it is the long-term recommendation for the Office of Environmental Stewardship.

OFFICE OF ENVIRONMENTAL STEWARDSHIP ACTIVITIES

This study focused on CU vendors' last mile because of feasibility and data possible for CU vendors to provide in the nearterm. As CU solidifies the quantification of the last mile transportation stage, the next stage would be to work further upstream to look at transportation beyond the vendors' final distribution center.

Immediate Next Steps: The Office of Environmental Stewardship should contact the CU procurement or purchasing office to identify which CU vendors might have the greatest impact on Scope 3 freight emissions, i.e. vendors with which CU spends the greatest amount or vendors who might have nationwide manufacturing and distribution rather than only local operations. One vendor type to investigate in particular is food vendors, as food products are likely to arrive in CU from various locations across the country. As these vendors are identified, the office can begin assessing and reporting emissions from such vendors using the framework (Appendix C).

Of the three methods (fuel-based, distance-based, and spend-based), the spend-based method is possible to calculate without direct input from the vendor because it translates spend on the vendor to greenhouse gas emissions. However, it is the most inaccurate method of calculation of the three because there are many assumptions required to create the emissions factors to translate currency to greenhouse gas emissions.

According to the Greenhouse Gas Protocol, the fuel-based calculation method is most accurate because it translates direct fuel combustion consumed in the delivery of the goods to greenhouse gas emissions[28]. If CU vendors provide fleet information and location of their distribution center, then it is the most straightforward and data-possible method, proven from work with Staples and the CU's mailroom.

Once data collection efforts are expanded, the office can work on shifting calculations to the GLEC Framework to utilize the distance-based method for freight transportation as it is becoming accepted as the golden standard in the freight industry. The GLEC Framework will also be useful when considering how best to calculate emissions further upstream, prior to the last mile.

OFFICE OF ENVIRONMENTAL STEWARDSHIP ACTIVITIES

RECOMMENDATION #14:

CONTINUE TO USE THE CLIMATE REGISTRY AS A REPORTING MECHANISM
(2023-)

TRACK EMISSIONS

REPORT EMISSIONS

There are multiple disclosure registries that CU can use to report their Scope 3 emissions and include the CDP and The Climate Registry. CDP is a voluntary disclosure system that allows investors, companies, cities, and states to report their Scope 1, Scope 2 and Scope 3 emissions[29]. The Climate Registry is a non-profit organization that is focused on gathering emissions data for North America only. Reporting emissions to a registry or database encourages organizations to be transparent throughout the reporting process[30].

The Office of Environmental Stewardship established a base year of 2019 to report Scope 1 and 2 emissions data to The Climate Registry. It is recommended that CU continue to report annually to The Climate Registry, and expand its reporting commitment to include Scope 3 freight emissions data. Furthermore, the GHG Protocol's Corporate Accounting and Reporting Standard states that GHG reductions have to abide by various state, national, or regional regulations within a specific geographic area[31].

Using the same database would allow the university to report emissions annually in order to track annual progress toward reducing GHG emissions.

Immediate Next Steps: The Office of Environmental Stewardship should expand its reporting commitment to include Scope 3 freight emissions data and dedicate resources toward meeting that commitment.

OFFICE OF ENVIRONMENTAL STEWARDSHIP ACTIVITIES

RECOMMENDATION #15:

CONTINUE COMMUNICATION WITH OTHER LEADERS IN THE HIGHER EDUCATION/SUSTAINABILITY SPACE
(2023-)

TRACK EMISSIONS

REPORT EMISSIONS

REDUCE EMISSIONS

The team had the opportunity to speak with representatives from numerous universities and corporations as well as representatives of city agencies. These interviews were crucial to the formulation of the recommendations laid out in this report. However, the team believes these conversations were only the preliminary steps in solidifying contact with other leaders in this space. The Office of Environmental Stewardship should remain in contact with the interviewees cited in this report.

For example, the NYC Economic Development Corporation (NYCEDC) has indicated interest in collaborating with a leader such as CU on freight issues. NYCEDC has offered ideas on new innovations for freight transport in the city, including ways to further utilize maritime transport in Northern Manhattan.

While the team was able to connect with many industry experts and experienced operations managers, due to time constraints many of the individuals contacted were not available to share their insights. The team recommends continuing outreach to these contacts.

Immediate Next Steps: The team will provide all relevant contact information to the client so that OES can continue fostering these relationships and gaining new perspectives on the freight emissions landscape.

Limitations to "Ongoing Consideration" Recommendations:
Almost all universities and corporations interviewed reported that data collection from the hundreds of vendors that serve CU is the most challenging aspect of tracking and reporting emissions because a centralized data collection system is not in place. It could take many years to establish this system, making it difficult to calculate a baseline year that is consistent. Therefore, any emissions reductions that are realized have the potential to be over or underestimated.

TIMELINE

Given the urgency of the climate crisis and the long term net zero 2050 goals to which CU has committed, it is important to implement time-bound emissions reduction goals. The team has provided a draft timeline for implementation of the above recommendations between 2023 and 2030.

2023

- Training Workshops for Operations Staff
- Educational Workshops for Administrative Staff
- Partner with Student Sustainability Organizations
- Leverage Existing Communications Channels with Students

2024

- Adjust Vendor Minimum Spend
- Centralize Purchasing Control
- Work with Vendors to Consolidate Deliveries
- Revise Vendor Contracts to Require Data Sharing of Fleet Transportation
- Designate and Enforce Specific Delivery Zones for CU Campus
- Maximize Existing Mail and Delivery Tracking Technologies

2025

- Greening Contracts
- Expand Administrative Mail Operations

2030

- Calculate Last Mile Emissions for All Vendor Transportation using the Vendor Last Mile Transportation Emissions Calculations Framework
- Continue to Use The Climate Registry as a Reporting Mechanism
- Continue Communication with Other Leaders in the Higher Education/Sustainability Space

CONCLUSIONS

Calculating Scope 3 emissions in full takes dedicated resources to gathering, processing, and analyzing the data. Due to the limited timeframe of this capstone project, the team worked closely with the Office of Environmental Stewardship to identify priority areas for the project.

The initial phase demonstrated the broad and complex nature of calculating not only GHG emissions attributed to freight transportation, but calculating Scope 3 emissions as a whole. The GHG Protocol recognizes that calculation methods, processes, and thus accuracy, of Scope 3 emissions will vary across categories based on assumptions utilized, categorization chosen, and emission factors used. However, Scope 3 emissions represent the largest sources of carbon emissions emissions for most organizations, and the

greatest opportunity to influence GHG Reductions in the value chain[32]. As discussed, reducing overall reliance on freight transportation also offers co-benefits for NYC that include reduced congestion on roadways and improved traffic safety.

Collaboration with vendors, including "greening" vendor contracts, will provide the strongest opportunities to both track and reduce freight emissions. While the sequence of the traditional approach recommended by the GHG Protocol is to track emissions, set targets and then reduce emissions, this team recognizes that working strategically with vendors to reduce emissions prior to having a complete inventory is a prudent approach to reducing emissions from freight to impact both the vendor's Scope 1 emissions and CU's Scope 3 emissions. Furthermore, these efforts can help achieve even broader reductions across the country if vendors establish practices with CU that are replicable on other university campuses.

As CU's Office of Environmental Stewardship begins to tackle the issue of Scope 3 freight emissions, the university is leading the way for other higher education institutions. Continued focus in this direction improves the university's transparency and ultimately its progress toward achieving the Plan 2030 goals.
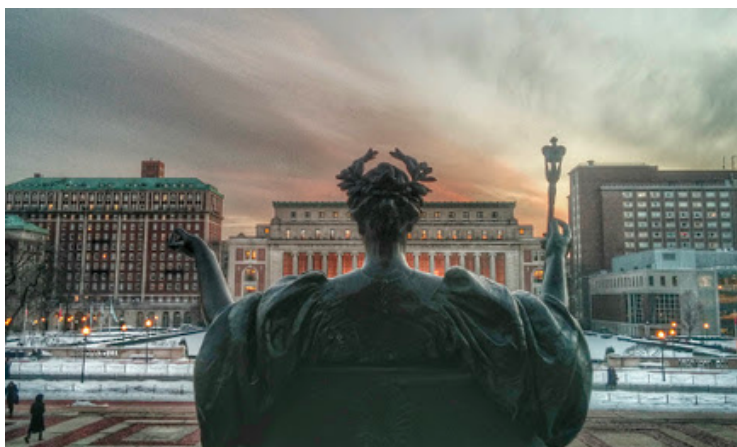
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APPENDIX A: STAKEHOLDER INTERVIEW GUIDE FOR UNIVERSITIES AND CORPORATIONS

UNIVERSITY SCOPE 3 MANAGEMENT QUESTIONS:

This comprehensive list of potential questions was developed to guide interviews with universities that are interested in or are already tracking Scope 3 emissions as a part of their sustainability goals. They were arranged in no particular order and served as a guide to understand best practices at other learning institutions.

1. How does your organization define Scope 3 emissions?
2. What Scope 3 emissions are you currently reporting on? (not necessary if they have it on their website/sust plan/report)
   a. Potential follow up #1: If Category 1, Category 4 or Category 9 of Scope 3: Corporate Value Chain standard, please provide a high level outline of what this entails?
   b. Where or what category does the bulk of your Scope 3 emissions come from? …Why do you think that is? (not necessary if they have it on their website/sust plan/report)
   c. Is there anything outside the scope you described that the University is planning to include in future reporting.
3. Scope 3 emissions, especially compared to Scope 1 and 2, are harder to measure.In our research we found organizations mainly use the World Resource Institution's Scope 3 Calculation Guidance or the GHG Protocol to calculate emissions. How do you recommend tracking Scope 3 emissions within an organization or more narrowly a University from your experience?
4. Do you include upstream and downstream emissions producing activities within your tracking and reporting?
5. What is the University currently doing or planning on doing to lower their Scope 3 emissions?

UNIVERSITY FREIGHT MANAGEMENT QUESTIONS:

1. What does your organization define as freight?
   a. Potential follow up #1: Do you agree with this definition, and if yes or no, how would you elaborate on this definition at all?
   b. Potential follow up #2: Is there a reason your university has not looked at its freight management?

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2. Please give examples of what you would include in freight (vs. other delivery services such as mail)?
3. What are your overall goals for carbon reduction? (not necessary if they have it on their website/sust plan/report)
4. Is your university examining the financial, social, and environmental benefits of improving freight sustainability at all?
5. What are the barriers preventing you from measuring and reporting this data?
6. What do you recommend focusing on instead and why? What is your advice to a fellow academic institution?
7. What data is available to you, or how would you access data related to your freight emissions? What data is not available to you that you would need if you wanted to begin tracking and reporting freight emissions?
   a. What kind of metrics would you use to track the environmental performance of freight carriers? (Examples: grams of CO2 emitted for every ton of freight moved per mile, NOX, PM, black carbon?)
8. What departments would need to be involved in gathering the information required for tracking freight emissions?
   a. What kind of metrics would you use to track the environmental performance of freight carriers? (Examples: grams of CO2 emitted for every ton of freight moved per mile, NOX, PM, black carbon?)
9. What methodology do you use for calculating emissions?
   a. If the GHG Protocol is used, what Scope 3 category(ies) do freight emissions (both inbound and outbound) fall under and why?
   b. To what extent do you rely on models and estimation techniques for emissions calculation?
10. What framework do you follow for reporting emissions?
11. What methodology do you use for tracking emissions? Are there any resources you would recommend using for tracking freight emissions?
12. What organizations does your university report this information to? Is it publicly available?
13. Are there any initiatives to educate students on how they can change their behavior to reduce freight emissions? Can you describe them?
14. (MIT specifically) Do you think using the GLEC framework is a practical approach to help Columbia University lower its freight-related emissions? Or, what do you think is a good starting point to start lowering, tracking, and reporting freight emissions?

INTERVIEW GUIDE FOR POTENTIAL CORPORATIONS TRACKING SCOPE 3 EMISSIONS:

This comprehensive list of potential questions was developed to guide interviews with corporations that are tracking Scope 3 emissions. They were arranged in no particular order and served as a high-level guide. The next steps would be to apply these questions to shippers, carriers, and logistics service providers that have existing purchasing partnerships with Columbia University and deliver cargo to the university by means of road freight.

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1. How does your business define freight and the boundaries of emission?
2. How is delivery and/or freight central to your business operations?
3. Could you tell us a little more about your role in freight operations for the company?
4. Could you tell us a little bit about your Scope 3 emissions strategy? What framework do you currently use to track Scope 3 emissions?
5. How does your corporation define "freight?"
6. Does your company have current carbon reduction goals? How does freight play into the carbon reduction goals / how big of a role will freight efficiency / emission reduction play in the goal?
   a. Do you have specific goals for freight?
   b. Have there been any programs to select cleaner and more sustainable carriers in the freight procurements?
7. What is the freight capacity of your company? Eg. Size of the company and methods of freight: rail, road, air, marine
8. Could you define the upstream and downstream activities of freight? With respect to the origin and destination of freight-related activities at your company?
9. What is the freight emission reduction strategy of your company?
   a. If electrification, how does this work with current electrical charging infrastructure? Is the company working to increase EV charging? Incentives?
10. What kind of metrics does your company use to track the environmental performance of freight carriers? (Examples: grams of CO2 emitted for every ton of freight moved per mile, NOX, PM, black carbon?)
11. Does your company currently report scope 3 emissions?
    a. Is freight / delivery included in the scope 3 emissions?
    b. What framework do you use to prepare the report? Who do you submit your findings to?
    c. What methodology do you use to calculate the emissions?
    d. Any proxies for missing data that you recommend / resources for intensity calculations?
12. If freight is not the biggest impact of Scope 3 emissions for your company, what categories of Scope 3 are the biggest contributors to GHG emissions that you have found while tracking Scope 3 emissions?
    a. Are there other activities in transport of material that you have found have greater impact than freight / delivery?
13. What are some of the challenges you have faced in tracking Scope 3 emissions data?
    a. Which departments do you work with to collect the information? Which have the most robust datasets?

APPENDIX B: MANHATTANVILLE LOADING DOCK SITE VISIT SUMMARY AND RECOMMENDATIONS

Location: 615 W 131st St, New York, 10027

Background:
Manhattanville Loading Dock is the largest loading dock across all CU Campuses. It is a shared loading dock for four separate buildings. The loading dock receives about 60 individual deliveries per week. Regular vendors are expected to schedule deliveries by appointment to limit the number of trucks that arrive at the same time, and thus reduce unnecessary vehicle idling. This is done through a software system called DataDocks, a program that also records delivery vehicle arrival and departure times. Upon arrival, packages and goods are scanned by the operations staff and sorted by location. They are then cleared for desktop delivery by the operations staff. The loading dock is equipped with its own electric forklifts, electric vehicles and charge station.

The Process:
As trucks arrive, the CU staff organizes packages according to their final destinations. Staff record both vehicle arrival and departure times, as well as the number of packages received. If the package is from USPS, the manifest information is also recorded. Once packages are separated, the CU staff delivers the packages to their final destination on foot.

Existing Reduction Strategies:
The Manhattanville Loading Dock is the campus' central delivery center and it accepts deliveries from all carriers. Unlike on other campuses where FedEx, UPS and Staples Inc. might make desktop deliveries, the presence of the loading dock on the Manhattanville campus streamlines vendor deliveries and reduces time lost or emissions wasted to parking searches, unnecessary idling and traffic congestion. The operations staff transports packages on foot through underground corridors to four separate buildings.

Recommendation:
The loading dock staff is currently scanning packages to capture the arrival time and number of packages received. As UPS and FedEx Tracking numbers carry weight information, this information could also be scanned into the DataDocks software program. This data can then be used to calculate Scope 3, Category 4 Last Mile Emissions for UPS and FedEx packages.

APPENDIX C: VENDOR LAST MILE TRANSPORTATION EMISSIONS CALCULATIONS FRAMEWORK

<u>Purpose of the Framework</u>

A Scope 3 inventory, according to the GHG Protocol, accounts for companies or universities to quantify the value chain emissions impact for six main greenhouse gasses[33]. The main source of transportation and freight emissions in Scope 3 comes from the combustion of diesel gas used by vendors' trucks, resulting in emissions of carbon dioxide, methane, nitrous oxide, black carbon, and more. The goal of this framework is to calculate the emissions from CU vendors' last-mile deliveries on road transport, which falls under Scope 3: Category 4 because it quantifies the emissions of transportation between CU's tier 1 suppliers and its campuses[34].

The calculation framework serves as a guide to calculate the greenhouse gas footprint of CU's vendors' last mile road transportation. The Framework calculates the individual emissions for carbon dioxide (CO_2), methane (CH_4), and nitrous (N_2O) oxide in tons. These are the most commonly reported greenhouse gas emissions according to the GHG Protocol[35]. The formula for calculation of carbon dioxide equivalents in tons is as follows:

$$t (CO_2) + t (N_2O) + t (CH_4) = t (CO_2e)$$

<u>Calculation Boundaries</u>

This framework focuses on the last mile for three reasons: to provide consistent methods to quantify emissions from vendors' final distribution center to Columbia campuses; feasibility of obtaining required freight related data from vendors; and direction provided by CU's Office of Environmental Stewardship. The last mile is defined here as the distance from a good's final distribution center to its respective Columbia campus.
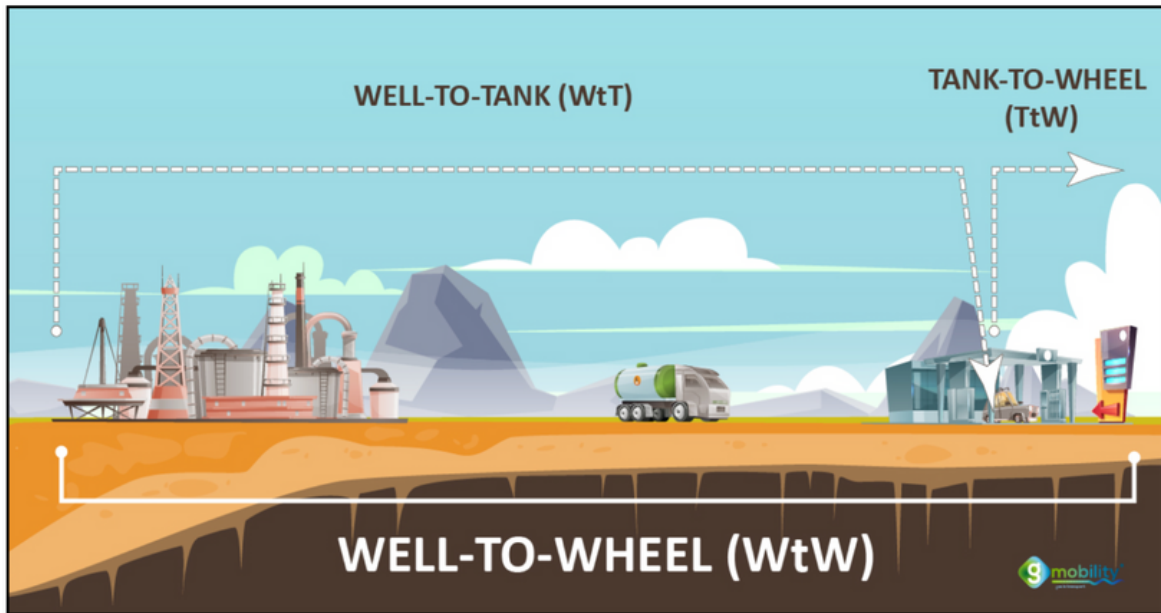
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Figure 4. Fuel Life Cycle[36]

The main source of GHG emissions from freight transportation comes from the combustion of fuels during transport. As such, it is important to examine the fuel life cycle. According to the GLEC framework, the fuel life cycle consists of two key stages: well-to-tank (WTT) and tank-to-wheel (TTW). WWT focuses on fuel production and distribution and TTW focuses on fuel combustion. Together, they account for the full fuel life cycle emissions in well-to-wheel (WTW)[37]. In other words, WTT encompasses the emissions before the fuel is extracted from the pump and TTW embodies the emissions once the fuel is in the vehicle (Figure 4). This project on last-mile deliveries represents partial accounting of TTW emissions .

The transportation of goods and services by CU's vendors from the final distribution center to CU's campuses falls into the GHG Protocol's Scope 3: Category 4 - "Emissions from outsourced logistics services used to transport or distribute products from tier 1 suppliers to company facilities or transport between campus facilities. "

It is important to note that the the vendors' last-mile transportation emissions are not included in Scope 3: Category - Purchased Goods and Services because at that stage the good has left its manufacturing facility and Scope 3: Category 1 embodies emissions from 'cradle-to-gate', including transportation up until it leaves its manufacturing facility[38][39].

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Due to the boundary of this study only looking at the last mile from the final distribution center to Columbia campus, all goods will have left their manufacturing facilities and emissions should be included in Scope 3: Category 4. Overall, the emissions in this calculation framework fall into the TTW fuel combustion of vendors' vehicles and should be reported in Scope 3: Category 4.

The framework described below summarizes the three steps of calculating last mile emissions from a freight delivery by a vendor to a CU campus.

Framework
Step 1: Vendor Data Availability and Assessment
Step 2: Select Distance Based, Fuel Based or Spend Based Calculation Approach
Step 3: Prioritization and Analysis

Step 1: Vendor Data Availability and Assessment
To determine the appropriate calculation approach for emissions and to calculate the impact of vendor transportation, it is necessary to understand the delivery process, location, and frequency of the vendor's interactions with CU. A process map can be developed to demonstrate how these components interact. A process map can include the fleet make-up of the delivery trucks, the specific CU campuses and addresses receiving the goods, delivery frequency, and an accurate measurement of volume and mass of goods. Example process maps are provided in the case studies below (Figure 6 and Figure 7).

The following information is necessary to generate a process map for a vendor:

Process Mapping Information:
- Frequency (or number) of deliveries: the frequency of deliveries between final vendor distribution centers to Columbia campus in a given time period (e.g. per week or per year).
- Address of final vendor distribution center: this is the location of the distribution center and is used to calculate the distance between the DC and CU
- Address of Columbia delivery location: receiving location at CU where goods are handed off to CU personnel
- Vehicle fleet information: The make, model, year, fuel-type, weight-class, engine-class, and vehicle-type of the fleet delivering the goods from the final distribution center to CU, which determine mpg, diesel consumption methods, and inform reduction strategies

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The following is a set of recommended questions for CU to each vendor to develop a process map:

Data Availability:
- **Distance**: The distance between distribution center address and CU delivery address. If many routes are possible, it is ideal for the vendor to provide the exact distance and/or route taken to Columbia campus to deliver the goods.
- **Mass or Volume**: The mass and/or volume of the goods delivered to CU. Mass is preferred over volume, where possible. If volume actuals are available, then volume should be used. If mass and volume actuals are not available, the volume of the truck in twenty-foot equivalent units (TEUs) should be used.
- **Fuel log**: The fuel receipts or spend or volume of fuel used to refuel trucks between the final distribution center and CU.
- **Spend data on transportation**: Total spent by the vendor on transportation from the final distribution center to CU. The spend information is frequently tracked by the vendor and requests from the vendor on that spend information should be readily available.

Step 2: Select Distance Based, Fuel Based or Spend Based Calculation Approach

The emissions calculation approach is selected based on the type of data available (distance-mass/volume, vehicle type and mpg, fuel receipts and logs, and/or spend data). This section provides a decision tree to guide the user through choosing a calculation approach.

According to the GHG Protocol, there are three primary approaches to calculating the last mile Scope 3: Category 4 TTW emissions: distance-based, fuel-based, and spend-based. The distance-based approach considers the distance traveled and mass or volume of the goods to calculate the GHG emissions footprint of the vendor's travel to CU. The fuel-based approach considers the fuel consumed during transport from the final distribution center to Columbia campus. The spend-based approach considered transportation costs incurred by the vendor to transport goods from the final distribution center to Columbia campus.

Using the database of emission factors provided by the EPA Emission Factors Hub, all three methods allow calculation of the vendor's GHG emissions in carbon dioxide (CO_2), methane (CH_4), and nitrous (N_2O) oxide, which when added together provide a figure in carbon dioxide equivalents.

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The fuel-based approach is likely the most feasible to calculate for many vendors as fuel use (in miles per gallon) of the vehicle and distance are generally known. This approach is the most accurate as it tracks exact emissions. Distance-based is the second best option but it is challenging to gather accurate mass or volume data of the goods delivered, and spend-based is the least accurate because of the requirement of assumptions made in creating its emission factors so it should be used as a last option[40].

For example, if the vendor provides distance and mass data, CU should calculate emissions using the distance-based method in accordance with the guidance from the GLEC framework. If there is no distance or fuel data, the user should use a spend-based approach using the data from the GHG Protocol and Emission Factors Hub. If the shipper or carrier is registered with the US EPA's Smartway program, they will compile emissions data and CU can access this data from Smartway.

Figure 5 depicts a decision tree, created using both GLEC framework[41] and GHG Protocol Scope 3 Category 4 calculation framework[42], for making a decision on calculation approach.
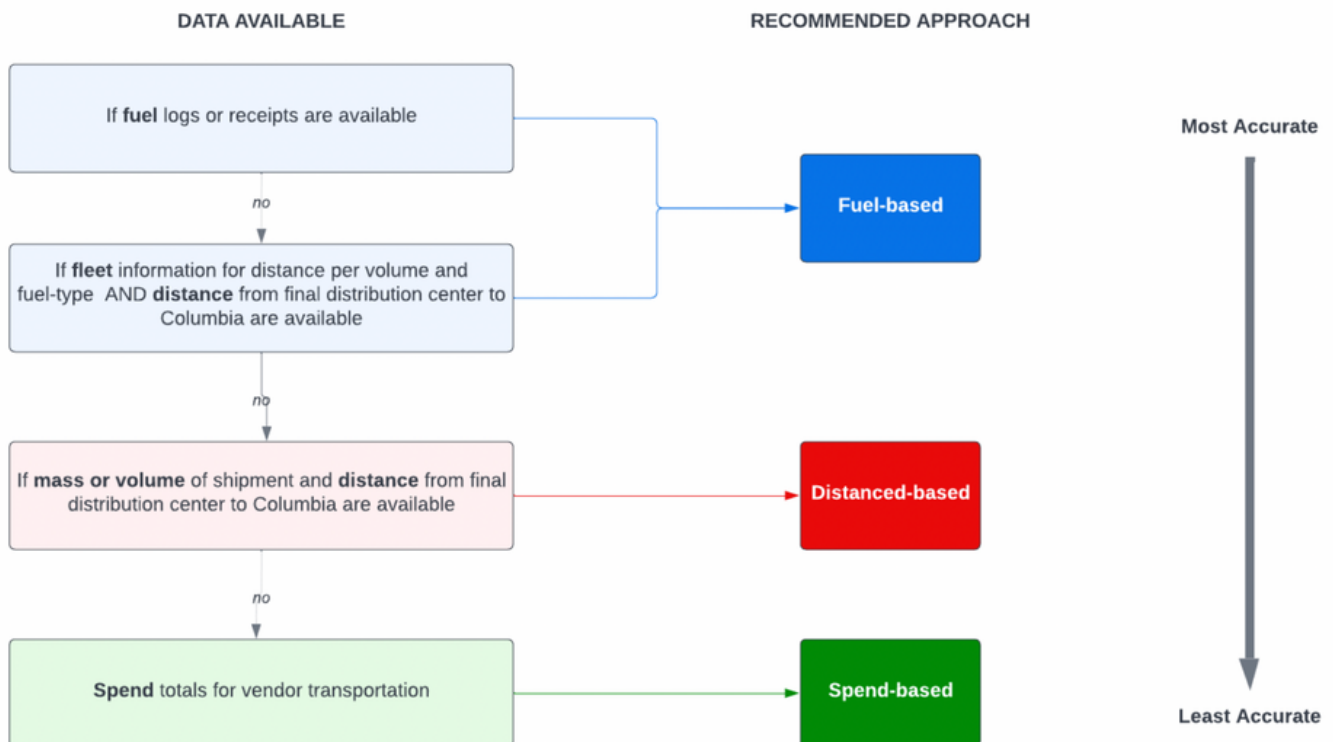

Figure 5. Decision tree to guide calculation approach for freight in Scope 3 Category 4.

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Fuel-Based:

The fuel-based method calculates emissions from vehicle fuel use. Fuel use can be derived from volume of fuel consumed, dollar amount spent on fuel and average price of fuels; distance traveled and vehicle fuel efficiency, and dollar amount spent on transportation services and share of cost spent on fuel. The fuel-based method is often more accurate than distance-based. If fuel-based is not possible, carbon emissions should be calculated using the distance-based method. It is important to ensure that any emissions factors being used are referencing volume of fuel per greenhouse gas equivalent.

Inputs:
- Volume of fuel consumed. The calculation options to quantify are:
  - Distance in miles divided by miles per gallon factor multiplied by adjustment factor 1.05 to account for distance variation.
  - Total dollar amount spent on fuel divided by average fuel price per Unit-of-Measure (UOM)
  - Amount spent on transportation services and fuel cost share.
- Emissions factor (EF) from EPA fuel logs in fuel emissions factor that translate greenhouse gas emissions from volume of fuel provided[44].

Formula:

GHG *emissions(fuel)= volume of fuel consumed x EF*

Volume of fuel consumed(gallons) =
(vehicle miles traveled x 5% distance variability adjustment factor)/avg. miles per gallon

Distance-Based:

This method uses distance driven multiplied by mass or volume of goods transported and an emissions factor to quantify GHG emissions. The emissions can be calculated using a tonne-kilometer emissions factor figure or a twenty-foot equivalent unit (TEU)-kilometer figure. TEU-kilometer is a unit of measure representing one twenty-foot container equivalent of goods over one kilometer. The distance-based method is especially useful when there are no fuel or mileage records. Accuracy is generally lower than fuel-based methods as assumptions are made about average fuel consumption and mass or volume of goods. It is important to ensure that any emissions factors being used are referencing distance and mass or volume per greenhouse gas equivalent.

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Inputs:
- Distance from vendor to delivery site.
- Mass or volume of goods transported from the vendor.
- Emissions factor (EF) in kilometer-tonnes per greenhouse gas. Emissions factors for SmartWay participants are published each year and can be downloaded from the SmartWay webpage[45]. If the vendor in question is not listed in this spreadsheet, the GLEC framework provides emissions tank-to-wheel per vehicle type in the GLEC Framework Document[46].

Formula:
GHG Emissions (distance) = (Distance x 1.05 adjustment) x Weight x EF

The adjustment of 5% accounts for any variation on the route from distribution center to Columbia campus. The 5% is based on a recommendation in the GLEC framework[47].

Spend-Based:
If data is not available to prepare a fuel-based or distance-based calculation, spend-based methods can be used to calculate emissions. The spend-based approach translates dollars spent on transportation to greenhouse gas emissions. The emissions factors are determined through Environmentally-Extended Input-Output (EEIO) models that specify greenhouse gas emissions per dollar spent. The spend-based method is effective for initial screenings to select vendors to prioritize. However, spend-based results carry a higher level of uncertainty compared to fuel-based and distance-based methods. It is important to ensure that any emissions factors being used are referencing the appropriate currency per greenhouse gas equivalent.

Inputs:
- CU's spend on vendor transportation from the final distribution center to CU.
- EEIO emissions factor with greenhouse gas emissions per spend. The GHG Protocol hosts EEIO databases with emissions factors on their website and publishes new models as they become available[49].

Formula:
GHG Emissions = Spend x ($) Emissions Factor

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Step 3: Prioritization and Analysis

The calculations above provide flexibility for different quantification methods as Columbia continues to receive more data from its vendors to quantify transportation emissions.

By completing Steps 1 and 2, Columbia can track the quantity of emissions to report to The Climate Registry, and identify high emitting vendors and design specific emission reduction strategies.

If fuel-based calculations are made, then a consistent emissions intensity figure can be determined looking at GHG emissions per delivery or order from the vendor. If distance-based calculations are possible to calculate per vendor, a further analysis of the figures can be completed by calculating an emissions intensity value by looking at the emissions divided by tonne-kilometer (mass x distance) of the transportation of the vendor. Analyzing the results through either a per visit or distance intensity allows for prioritization of the vendors to approach for reduction strategies by targeting the highest impact vendors first[50].

A prioritization matrix is helpful when using the spend-based method. If the office of procurement can provide spend data, the quantity of orders from various vendors can be understood. Then spend based data can be used to convert the transportation fees to GHG emissions values in order to determine highest impact vendors.

APPENDIX D: APPLIED CASE STUDIES - COLUMBIA'S FREIGHT ACTIVITY

The following case studies focus on key aspects of Columbia's inbound freight activities for two vendors that make daily or near-daily deliveries to CU campuses. The case studies discuss important factors that impact the freight emissions from these vendors such as: delivery location, method of transport and frequency of deliveries to the university. Additional factors that impact freight emissions and are discussed below are student and faculty purchasing behavior, procurement practices and vendor relationships.

Case Study 1: Morningside Heights Mail Delivery

Serving all thirty of Columbia's undergraduate residence halls, the Student Mailroom on the university's Morningside Heights campus has witnessed firsthand the exponential growth in e-commerce in New York City. Together with the introduction of free and (almost) instant shipping, e-commerce has changed the landscape of both back to school and term-time shopping. The Student Mailroom now receives 50,000 and 22,000 packages during the Fall and Winter 'rushes', respectively. It is also seeing a 7% increase in packages received annually, which can be attributed to the undergraduate student population increase.

Conversely, given its limited size and capability, the Morningside Heights Administrative Mailroom has opted to receive only USPS mail, and not packages from other couriers. This means that more frequent ad hoc deliveries are made to individual school buildings and offices than would be the case if the Administrative Mailroom acted as a central delivery location for the campus.

Considering the regularity and increasing frequency of mail deliveries being made to Columbia by way of truck or van, as well as the extent of necessary data available to the Office of Environmental Stewardship, it is recommended that the University track the emissions from the "last mile" of deliveries to campuses.

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Step 1: Vendor Data Availability and Assessment

The Process:
USPS and six other courier services comprising Amazon, UPS, DHL, FedEx Ground, FedEx Express and FedEx Home, deliver mail once daily, Monday through Friday, from their respective local post offices (PO) or distribution centers (DCs) to the Student Mailroom at 70 Morningside Drive on Columbia's Morningside Heights campus. The total number of delivery days per year is roughly 250, and does not include national and university holidays.

Delivery vans pull up to the curb in front of the mailroom to unload their deliveries; they are met by mailroom staff, who take the load inside. If there is no room to pull up directly on the curb, trucks simply park in the traffic lane. Students are then notified via email when their packages have arrived at the mailroom. Mail is always collected by the students themselves from the mailroom, except sometimes during 'Fall Rush' when they may be required to collect from one of the makeshift overflow centers located elsewhere on the campus.

USPS is generally the only courier that also delivers to the Administrative Mailroom at 1202 Amsterdam Avenue. It does so twice daily, Monday through Friday, also with the exception of national and university holidays.

As with all deliveries to the Student Mailroom, USPS vans pull up to the curb or park in the bike lane. Once it has been dropped off, this mail is sorted by the mailroom staff and further distributed, either on foot or by the university's own fleet of inter-campus delivery vehicles, to offices, mailboxes or mailrooms on Morningside and other campuses. From these locations, individual recipients collect their mail. In addition to mail delivered to the Administrative Mailroom, irregular desktop deliveries are made by the full range of courier companies to individuals across the university on a daily basis, presumably for administrative, research and other academic purposes.
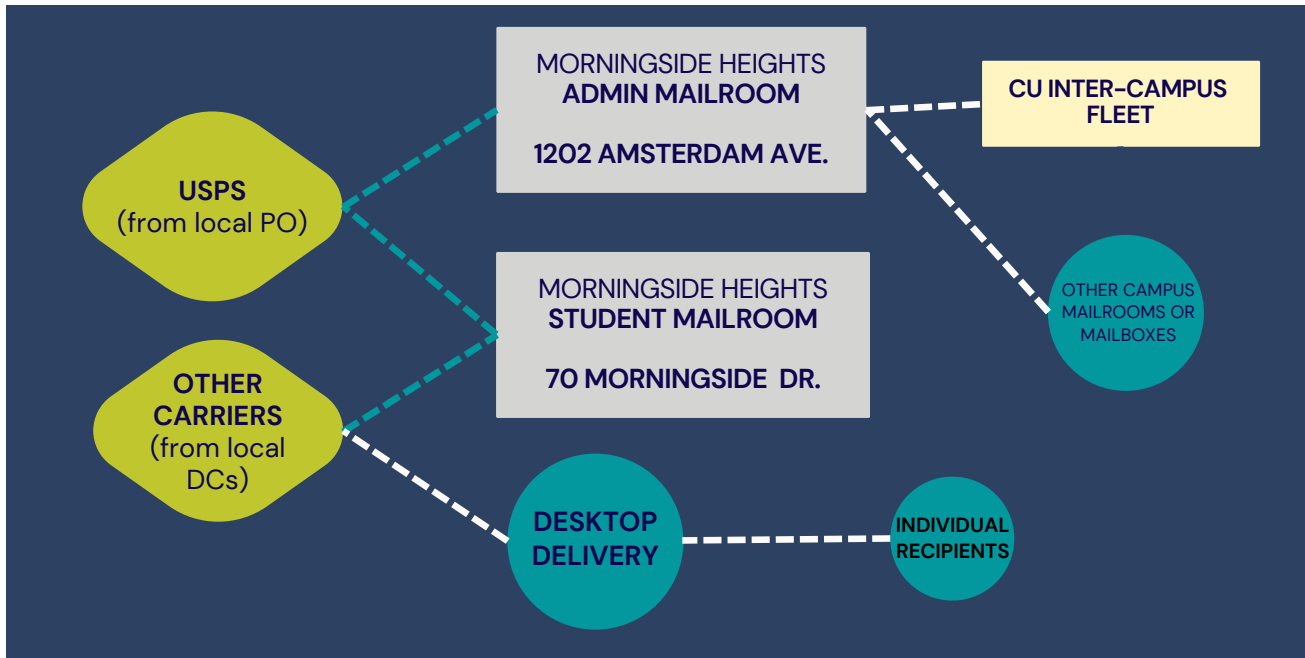
Process Map: CU Mail Deliveries

Figure 6. This process map describes the freight delivery process from the USPS last mile distribution center to the Administrative and Student mailrooms at CU.

Available Data:
The Morningside Mailroom team provided data related to this inventory, including:
- The number of annual deliveries made by each truck.
- The addresses of the specific local post office or distribution centers for each carrier.
- Truck models and number of trucks

Emissions from inter-campus deliveries are accounted for in the university's Scope 1 greenhouse gas inventory, and are beyond the scope of this project. Additionally, given the irregularity and decentralized nature of Columbia's daily individual desktop deliveries, their emissions are extremely difficult to track. It was therefore necessary to exclude individual desktop delivery activity from this inventory.

The mailroom inventory thus includes emissions from the twice daily weekday Administrative Mailroom deliveries of USPS, and the once daily weekday Student Mailroom deliveries of USPS, Amazon, UPS, DHL, FedEx Ground, FedEx Express and FedEx Home. According to the Mail and Transportation team, the abovementioned carriers account for around 70% of annual deliveries to the Student Mailroom. Those from less regular "boutique" carriers make up the other 30%. Though the mailroom staff notes that these types of deliveries are becoming more and more common, given the unavailability of relevant data it was necessary to exclude them from the inventory at this time.

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Step 2: Select Distance Based, Fuel Based or Spend Based Calculation Approach
Calculation Approach: Fuel-based method for annual distance
Reporting Year: January - December 2021.

> **Formula for the fuel-based calculation approach:**
> *GHG Emissions (CO2) = volume of fuel consumed (gallons) emissions factor (Kg/gallon)*
>
> *Volume of fuel consumed (gallons) =*
> *(vehicle miles traveled x 5% distance variability adjustment factor)/avg. miles per gallon*

Data Inputs and Assumptions

- The boundary for this calculation is the "last mile" of delivery, which is the distance between the couriers' local post office or fulfillment centers and CU.
- Fulfillment center location data for each of the courier companies was used to calculate the vehicle miles traveled to and from Morningside Heights every day.
- Vehicle type and vehicle model year were used to determine the correct fuel economy figures and relevant EPA emissions factors. The mailroom team was able to provide this information for all three daily USPS deliveries, but was not able to provide vehicle model years for any of the other carriers. It was assumed that all of the medium duty diesel trucks used by each of the courier companies were manufactured within the EPA's 2007 - 2019 vehicle year timeframe. After some additional desktop research, it was established that the fuel economies for such vehicles appeared to range between 7 and 9 miles per gallon; therefore, an average of 8 miles per gallon was chosen for this calculation.
- Google Maps was used to estimate the total miles driven per delivery to and from the distribution centers to Columbia's Morningside campus. An adjustment factor of 1.05, based on the GLEC framework, was included to accommodate any variations, including the fact that trucks may encounter road work or may have to use specific lanes which may increase mileage from the most efficient route mapped on Google Maps.
- For the purposes of this case study, 100% of emissions per delivery were attributed to CU in Scope 3; however, it is important to note that there may be instances when delivery emissions are shared when a single truck makes deliveries to multiple locations for different companies.

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Example Amazon Student Mailroom Delivery CO2 calculation:
Volume of fuel consumed (gallons) =
(7,350miles x 105% distance variability adjustment factor)/8mpg = 965.69 gallons

GHG Emissions (CO2)= 965.69 gallons x 10.21Kg/gallon = 9,849.46kg CO2

Scope 3 Emissions For Mail Deliveries

Table 1. Scope 3 Emissions for Mail Deliveries, Category 4 - Upstream Transportation and Distribution.

Vendor	Emissions Source	Total VMT	Adjustment Factor	Adjusted Total VMT	Total Fuel Consumed (gallons)	MtCO2	MtCH4	MtN2O	tCO2e
USPS									
On-Road Transportation: USPS Medium/ Heavy Duty Truck	Diesel	375.00	1.05	393.75	41.45	0.4231776	0.0000037	0.0000170	0.4279150
On-Road Transportation: USPS Light Duty Truck	Gasoline	310.00	1.05	325.50	20.87	0.1831981	0.0000030	0.0000009	0.1835384
On-Road Transportation: Avg Light Duty Truck	Gasoline	310.00	1.05	325.50	32.55	0.2857890	0.0000027	0.0000006	0.2860252
Amazon									
On-Road Transportation: Avg Medium/ Heavy Duty Truck	Diesel	14,700.00	1.05	15,435.00	1,929.38	19.6989188	0.0001466	0.0006652	19.8846226
UPS									
On-Road Transportation: Avg Medium/ Heavy Duty Truck	Diesel	1,300.00	1.05	1,365.00	170.63	1.7420813	0.0000130	0.0000588	1.7585040
DHL									
On-Road Transportation: Avg Light Duty Truck	Gasoline	3,150.00	1.05	3,307.50	330.75	2.903985	0.000028	0.000006	2.906385
FedEx Ground									
On-Road Transportation: Avg Medium/ Heavy Duty Truck	Diesel	5,400.00	1.05	5,670.00	708.75	7.2363375	0.0000539	0.0002444	7.3045553
FedEx Express									
On-Road Transportation: Avg Medium/ Heavy Duty Truck	Diesel	1,550.00	1.05	1,627.50	203.44	2.0770969	0.0000155	0.0000701	2.0966779
FedEx Home									
On-Road Transportation: Avg Medium/ Heavy Duty Truck	Diesel	5,400.00	1.05	5,670.00	708.75	7.2363375	0.0000539	0.0002444	7.3045553
TOTAL						41.79	0.0003	0.0013	**42.15**

Step 3: Prioritization and Analysis

Relevant Recommendations
- Recommendation #6: Work with CU operations and city leaders to establish Neighborhood Loading Zone or similar intervention to ensure there is space on the street for USPS drop-offs.
- Recommendation #7: Upgrade Morningside Heights Administrative Mailroom facilities and operations to allow for it to receive mail and packages from all courier services.
- Recommendation #8: Expand use of SC Logic software in mailrooms to ensure centralized and consistent data collection.

Case Study 2 Staples Inc. Last Mile Deliveries

For the purposes of calculating GHG inventory for Scope 3: Category 4, the team selected Staples Inc. Staples Inc. is Columbia's primary office supplies vendor. Staples makes several weekly deliveries to all of the university's campuses to fulfill orders for the over one thousand individuals authorized to make direct purchases from the company.

Step 1: Vendor Data Availability and Assessment

The Process:
Over 1,000 CU staff and faculty have access to place orders with Staples Inc. Staples Inc. delivers general office supplies with paper making up the bulk of orders. Each order has a minimum spend control of $35 and has to be approved by a manager before being processed. Given the frequency and volume of orders placed with Staples, the vendor delivers to all campuses multiple times per week via truck. If the order is in stock, Staples will likely deliver the order to CU using their own trucks. However, if the order is not in stock, the order will be fulfilled by one of Staples' suppliers and therefore be delivered by another third party courier (e.g. Fedex, UPS, etc). When Staples delivers to CU, they either deliver to the respective loading docks or in some instances directly to the desk of the person who placed the order. Staples has 22 distribution facilities, however the majority of orders delivered to CU come from Montgomery, New York (Location #683) and Putnam, Connecticut (Location #472).
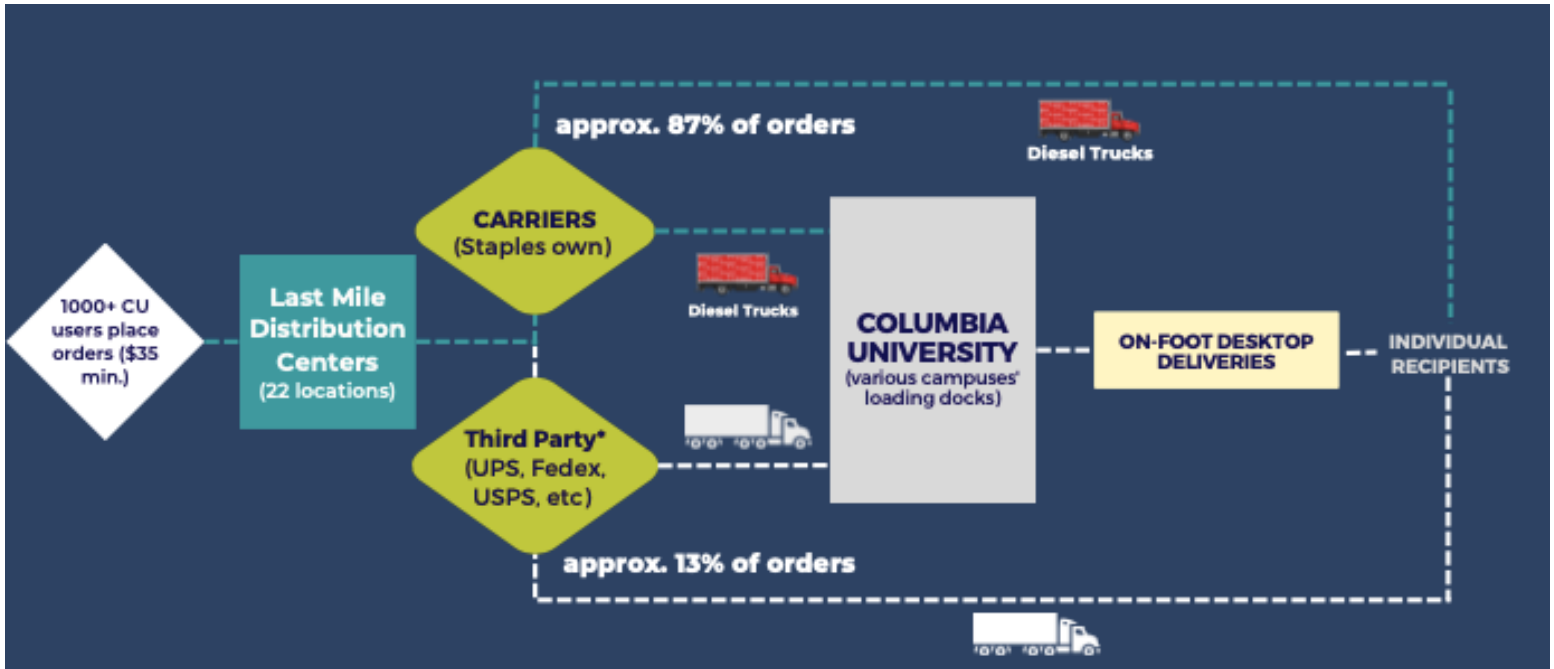
Process Map: Staples

Figure 7. This process map depicts the delivery process for Staples Inc. from its last mile distribution center to CU campuses.

Available Data:
In order to calculate the GHG inventory for Staples deliveries to CU, we obtained the following data

- A spreadsheet including the following data points: period by fiscal week, distribution location number, courier type, number of cartons, number of units and product type (paper vs. non-paper).
- A list of addresses for each distribution location.
- Average mile per gallon of Staples' owned trucks - 8.5 miles per gallon.
- Fuel type of Staples' owned trucks - diesel.
- Carton capacity of truck: 150 cartons.

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Step 2: Select Distance Based, Fuel Based or Spend Based Calculation Approach

Selected Calculation Approach: Fuel-based method for annual distance
GHG Emissions (CO2)= volume of fuel consumed (gallons) emissions factor (Kg/gallon)

Volume of fuel consumed (gallons) =
(vehicle miles traveled x 1.05 distance variability adjustment factor)/avg. miles per gallon

Reporting Year, January - December 2021
Data Inputs and Assumptions

- Based on the data provided by Staples Inc., 89% of total orders were fulfilled by Staples trucks and 82% of total orders fulfilled by Staples were coming from Montgomery, New York (Location #683) and Putnam, Connecticut (Location 472). The calculations for the Staples GHG inventory focuses on the 82% of orders coming from Montgomery and Putnam as this was viewed as the most material to the project goals. This data was obtained directly from the vendor.
- The boundary for this calculation is the "last mile" of delivery, which is the return journey distance between the Staples Inc distribution center and CU.
- Google Maps was used to estimate the total miles driven per delivery to and from the distribution center to Columbia's Morningside campus. An adjustment factor of 1.05 was included to accommodate any variations, including delivery to other CU campuses, as exact delivery addresses could not be verified. Additionally, trucks may encounter road work or may have to use specific lanes which may increase mileage from the most efficient route mapped on Google Maps.
- Staples provided the average miles per gallon per truck as well as truck fuel type. Staples also confirmed that calculations should assume truck manufacturing year would fall within the 2007-2019 range, which affects the choice of emissions factor.
- Number of cartons per delivery and total capacity of cartons per truck could have been used for distance/volume-based calculations, but ultimately calculations were made based on the fuel-based method instead.
- For the purposes of this case study, 100% of emissions per delivery were attributed to CU in Scope 3; however, it is important to note that there may be instances when delivery emissions are shared when a single truck makes deliveries to multiple locations for different companies.

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Staples Inc. Delivery Montgomery, New York (Fleet and Courier Only) calculation:
Volume of fuel consumed (gallons) =
(554,811 miles x 1.05 distance variability adjustment factor)/8.5mpg = 68,535.43 gallons

*GHG Emissions (kg/CO2)= 68,535.43 gallons 10.21Kg/gallon = 699,747 **kg/CO2***

Scope 3 Emissions For Staples Inc. Deliveries

Table 2. Scope 3 Emissions for Staples Inc. Deliveries, Category 4 - Upstream Transportation and Distribution

Staples Inc. Distribution Hub Location	Emissions Source	Activity Amount (vehicle miles traveled)	Adjustment Factor	Adjusted Activity Amount	Total Fuel Consumed (gallons)	MtCO2	MtCH4	MtN2O	MtCO2e
Montgomery, New York (Fleet and Courier Only)									
On-Road Transportation: Medium/ Heavy Duty Truck	Diesel	554,811	1.05	582,551.1	68,535.43	699.75	0.00553	0.02511	706.76
Putnam, CT (Fleet and Courier Only)									
On-Road Transportation: Medium/ Heavy Duty Truck	Diesel	148,656	1.05	156,088.8	18,363.39	187.49	0.00148	0.00673	189.37
					TOTAL	887.24	0.00702	0.03184	**896.12**

Step 3: Prioritization and Analysis

Relevant Recommendations:

- Recommendation #1: Increase the minimum spend order for Staples Inc. orders from $35 dollars to encourage larger orders and have fewer deliveries.
- Recommendation #3: Implement "Staples Delivery Days" policy in collaboration with Staples to allow 2 deliveries per week orders to be consolidated.
- Work with Staples Inc. to produce a "Small Order Reduction Calculator" report which will highlight potential ways to reduce emissions from Staples based on historical purchasing data. (Refer to Fig. 3 for sample report)
- Recommendation #5: Work with Staples Inc, a sustainability-focused company that is tracking Scope 1 and 2 emissions to develop a formal method for collecting data to track freight related emissions.

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