

U-M SCOPE 3 PURCHASED GOODS & SERVICES EMISSIONS FOOTPRINTING

By

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Abstract

This project was conducted to address recommendations from the University of Michigan's President's Commission on Carbon Neutrality by footprinting the institution's Scope 3 purchased goods and services greenhouse gas emissions. The research goals were to 1) develop methods for Scope 3 purchased goods and services (PGS) emissions footprinting; 2) partition emissions by spending category to identify high-impact purchasing categories; and 3) identify and recommend procurement system modifications to reduce Scope 3 PGS emissions and streamline progress tracking at the University of Michigan (U-M). The scope of this analysis encompassed all spending for fiscal year 2020 (FY 2020) across all U-M campuses and properties. Procurement data emissions were footprinted using sector-level supply chain emission factors (SEFs) from the 2019 EPA *Supply Chain Greenhouse Gas Emissions Factors for US Industries and Commodities* environmentally-extended input-output model. U-M spending data were disaggregated into spending accounts and assigned SEFs based on the alignment of spending account and SEF industry category descriptions.

Due to the uncertainty of SEF mapping to spending accounts, upper- and lower-bound emissions estimates were calculated by identifying the highest and lowest-impact assignments for each account. The true account footprint is assumed to lie between them. Some accounts saw only one SEF assignment and no bounds were estimated. Results yielded a Scope 3 PGS emissions footprint range of 373-1259 kiloton (kt) CO₂e. In many cases, multiple SEFs were assigned to a spending account because we were unable to determine specific spending activities within them. Averages were taken from SEFs assignments for each account, alongside their respective standard deviations. Account averages were summed to produce a total SEF assignment emissions footprint average of 673 kt CO₂e. Propagation of uncertainty was calculated at the account group level using the standard deviation statistics for all accounts they contained. Uncertainty also arose from the limited number of SEF categories (405 sectors) available in the EPA tool.

PGS account groups that dominated U-M's Scope 3 PGS footprint were 'Laboratory Research Supplies', 'General Expenses', and 'Plant Operation and Maintenance'. Recommendations fall into two categories: strategies for improved footprint tracking and emissions reductions. Interventions for improved emissions tracking include 1) mapping institutional purchases or spending accounts to EEIO categories (e.g., NAICS, UNSPSC codes); 2) expanding the use of M-Marketsite and incorporating measures for more detailed reporting of purchases when using P-Cards; and 3) updating the mapping of emissions factors to purchasing activities as accounts evolve. Interventions for reducing emissions include 1) encouraging the exchange of environmental product declarations (EPDs) from suppliers to make more sustainable purchasing decisions at the product level; 2) conducting outreach to the wider community of higher education institutions to develop a uniform sustainable procurement framework; and 3) exploring the use of existing asset management software to extract the greatest utility from fewer purchases.

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Acronyms and Abbreviations

BEA	United States Bureau of Economic Analysis
BLS	United States Bureau of Labor Statistics
CAMP	Carbon Accounting Modeling Project
CCP	Corporate Carbon Performance
CO _{2e}	Carbon Dioxide Equivalence
CPI-U-RS	Consumer Price index Research Series
EEIO	Environmentally-Extended Input-Output Model
EIO	Economic Input-Output Model
EIO-LCA	Economic Input-Output Life Cycle Assessment
EPA	United States Environmental Protection Agency
EPD	Environmental Product Declaration
GE	General Expenses
GHG	Greenhouse Gas
GHGRP	U.S. EPA Greenhouse Gas Reporting Program
GWP-100	Global Warming Potential Over 100-Year Time Horizon
IAT	PCCN Internal Analysis Teams
I-O	Input-Output
LCA	Life Cycle Assessment
LRS	Laboratory Research Supplies
NAICS	North American Industry Classification System
OCS	University of Michigan Office of Campus Sustainability
P-Card	Procurement Card
PCCN	U-M President's Commission on Carbon Neutrality
PGS	Purchased Goods and Services
PO	Purchase Order
POM	Plant Operation and Maintenance

PS	University of Michigan Procurement Services
SEFs	Supply Chain Emission Factors
SEC	United States Securities and Exchanges Commission
U-M	University of Michigan
USEEIO	United States Environmentally-Extended Input-Output Model

Executive Summary

The U-M Scope 3 Purchased Goods & Services (PGS) research team developed methods for tracking indirect emissions incurred by the University of Michigan from its procurement activities across its Ann Arbor, Flint, Dearborn and satellite facilities. Using the U.S. Environmental Protection Agency's *Supply Chain Emission Factors for U.S. Industries and Commodities* environmentally-extended input-output (EEIO) tool, the team mapped a variety of industry-level emission factors to the U-M financial operations account system. This model builds on the methods employed in the 2019 Carbon Accounting Modeling Report subgroup under the U-M President's Commission on Carbon Neutrality (PCCN) by mapping appropriate emission factors to their corresponding accounts. Using these methods, the team identified key leverage points for improved tracking of Scope 3 PGS emissions over time, in addition to system recommendations for emissions reductions in this carbon footprint category.

Model Description and Methods

In the absence of environmental product declarations with which U-M Procurement Services could compare environmental performance of goods and services between vendors, the EEIO approach was taken. Given data consistency limitations at the purchase item level, procurement data from Fiscal Year 2020 (FY 2020) were disaggregated into the accounts used by U-M Financial Operations for annual reporting procedures. Accounts that were categorically non-market expenditures (e.g., savings accounts, internal charges to university departments, etc.) were omitted from the analysis of the project. This study analyzed PGS activities defined by the Greenhouse Gas Protocol. Past PCCN works in overlapping Scope 3 PGS categories such as upstream fuel were excluded from the study. However, some PCCN subgroups employed extrapolation methods in their footprinting of Scope 3 categories like food or university-sponsored travel using limited consumption data. Furthermore, the food team used a mass-based approach for their estimations. Thus, the research team included these categories to understand the correlation between the two footprinting methods. We assigned a variety of industry-level supply chain emission factors (SEFs) to each account on the basis of SEF and account description alignment. In consideration for the diversity of goods and services that could be contained within each account, we generated ranges of emission totals for each account. GWP-100 values from the IPCC AR5 were used to represent Scope 3 PGS emissions in terms of CO₂e. The EPA SEF footprinting tool generated emissions intensities in terms of 2018 USD spending. Therefore, we relied on the Bureau of Labor Statistics' (BLS) Consumer Price Index Research Series (CPI-U-RS) to convert 2020 dollars into 2018 dollars. See Figures ES1 and ES2 for workflow diagrams of the project footprinting methods.

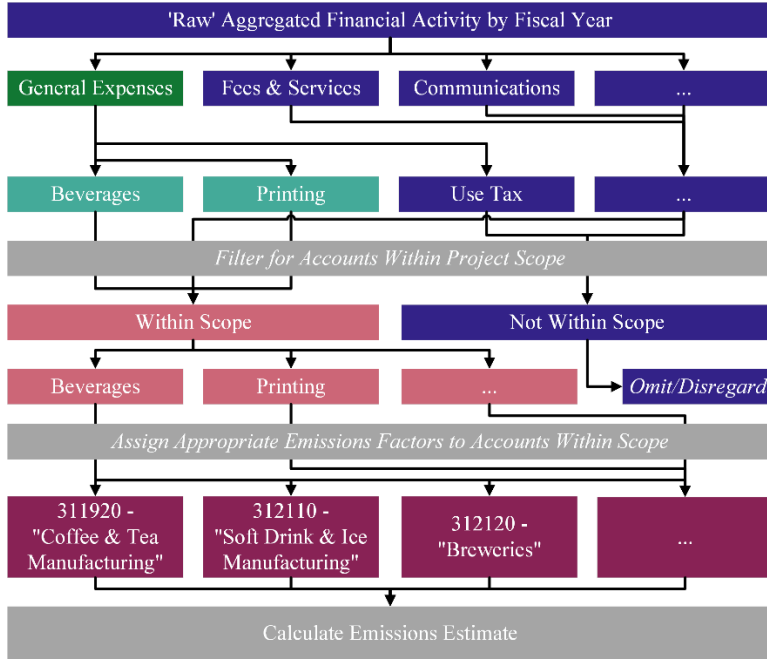


Figure ES1: Procurement Disaggregation, Scoping, and Emission Factor Assignments

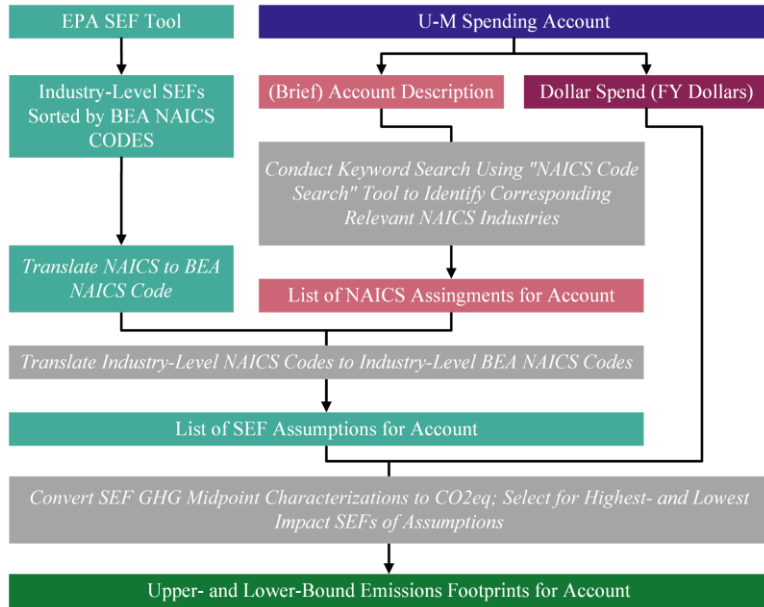


Figure ES2: Detailed Emission Factor Assignment Procedure

Results

Results yielded a Scope 3 PGS emissions footprint range of 373-1259 kt CO₂e. In many cases, multiple SEFs were assigned to a spending account because researchers were unable to determine specific spending activities within them. Averages were taken from SEFs assignments for each account, alongside their respective standard deviations. Account footprint averages were

summed to produce a total average Scope 3 PGS emissions footprint of 673 kt CO₂e. See Figure ES3 for the emissions footprint range and account SEF assignment emissions footprint averages.

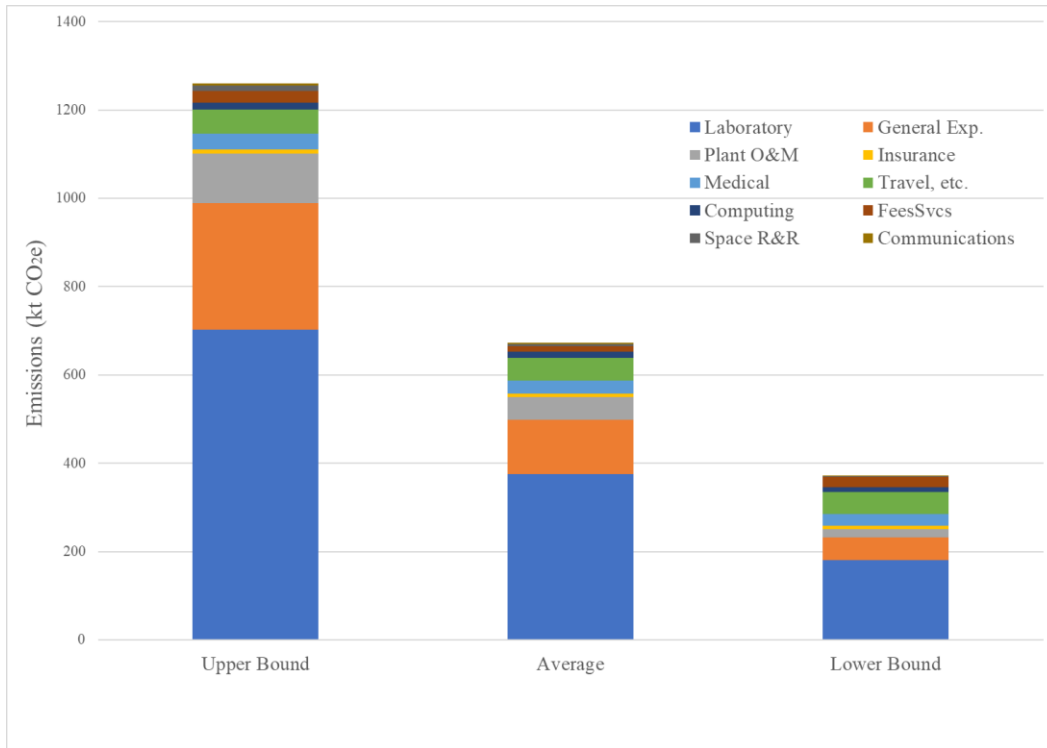


Figure ES3: FY 2020 Scope 3 PGS Footprint Range with SEF Assignment Averages Total

Recommendations

Recommendations for improving UM Scope 3 carbon accounting and management were organized into two categories: 1) changes for improved tracking; and 2) changes for Scope 3 PGS emissions reduction. Tracking of PGS emissions can become increasingly streamlined as the university develops data management methods that allow for mapping of individual purchases to appropriate emission factor industries (for example, North American Industry Classification System codes); encourages and expands the use of M-Marketsite to maximize data availability, while incorporating detailed reporting of purchases when using P-Cards; and updates emissions factor assignments as purchasing accounts evolve. Emission reductions can be achieved by encouraging the exchange of environmental product declarations so U-M Procurement Services can strategically select vendors of products or services on the basis of environmental performance; collaborate with other higher-education institutions to develop a standardized sustainable procurement framework; and explore the use of existing asset management software to extract the greatest utility from fewer purchases.

1. Background

1.1 Research Objectives

The goals of this research were to 1) develop methods for Scope 3 purchased goods and services (PGS) emissions footprinting; 2) disaggregate spending to identify key drivers of emissions; and 3) identify and recommend University of Michigan (U-M) system modifications to reduce Scope 3 PGS emissions and streamline progress tracking.

1.2 Context

Global scientific consensus affirms the irrefutable risks to social and ecological systems caused by anthropogenic climate change (IPCC, 2021). Such harms disproportionately, and progressively, fall on the world's most vulnerable populations in developing regions of the global south, while historical emissions are overwhelmingly attributable to developed nations (Gore et al., 2020). Climate-induced risks conform to the level of increase in average global warming (IPCC, 2021). In 2015, the United Nations Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5) posited that dramatic reductions in climate-related risks can be achieved by holding warming between 1.5°C and 2°C with respect to pre-industrial average temperature (IPCC, 2015). Seven years later, the Sixth Assessment Report (AR6) now projects 1.5°C warming in the near-term (2021-2040), with very high confidence (IPCC, 2021). AR6 furthermore communicates that substantial reductions in climate risk can be achieved by pursuing near-term actions that work to stabilize warming to 1.5°C (ibid.).

In both public and private domains, disclosure of climate risk data is increasingly demanded to inform investment risks, or conform to shareholder values (Flammer et al., 2021; Krueger et al., 2020). While no federal U.S. policy enforces climate risk reporting, in March of 2022 the United States Securities and Exchanges Commission (SEC) proposed rules that would expand mandated risk reporting from businesses to include those relating to climate change (U.S. Securities and Exchange Commission, 2022). Additionally, program participants must disclose their greenhouse gas (GHG) emissions according to the World Business Council for Sustainable Development's *Greenhouse Gas Protocol Corporate Accounting and Reporting Standard* scopes of emissions: Scope 1 (emissions generated on-site); Scope 2 (emissions associated with purchased energy services); and Scope 3 (value chain emissions such as commuting, purchasing, travel, waste, etc.) (Greenhouse Gas Protocol, 2021).

To date, the United States Environmental Protection Agency's (EPA) *Greenhouse Gas Reporting Program* (GHGRP) is the only nation-wide mandatory emissions reporting program in the United States (Busch et al., 2022; U.S. EPA, 2017). The GHGRP oversees facilities producing 25,000 metric tons CO₂e (t CO₂e) or more annually - whose collective emissions constitute approximately 85-90% of national GHG emissions (Busch et al., 2022; U.S. EPA, 2018). Voluntary reporting programs like the Carbon Disclosure Project obtain corporate carbon performance (CCP) data from companies through questionnaires (Busch et al., 2022; Carbon Disclosure Project, n.d.). Where mandatory programs largely cover Scope 1 (direct) emissions alone, voluntary programs also provide organizations with the opportunity to generate CCP estimates for Scopes 2 & 3 (indirect) emissions (Busch et al., 2022). Finally, third-party estimate

procedures see external organizations approximate CCP data using a variety of life cycle assessment (LCA) footprinting methods (Busch et al., 2022). The Greenhouse Gas Protocol (GHG Protocol) standard has published guidance for the calculation of organizational footprints (Barrow et al., 2015; Bhatia et al., 2015).

Though the terminology of CCP describes the environmental performance of private firms, climate change demands deep decarbonization in all sectors supporting the economically mature nations who drive the climate crisis. Beyond training the next generation of sustainability leaders, the higher education sector too must address its relationships with emissions (Institution of Mechanical Engineers, 2020). Various universities across the United States are committed to quantifying, tracking, and reducing their institutional emissions (Stanford University, n.d.; Harvard University, 2022; Yale University, 2021; MIT, 2021; UC Berkeley, 2016). Guided by this understanding, the University of Michigan's (U-M's) *President's Commission on Carbon Neutrality* (PCCN) – composed of various stakeholders and experts from all levels of U-M – was tasked with exploring and recommending strategies for institutional carbon neutrality in February of 2019. In March of 2021 the commission released their report which presented analysis-informed recommendations and the U-M president's office then set targets for Scope 1 neutrality by 2025, and elimination by 2040; Scope 2 neutrality by 2025; and establishing goals for Scope 3 neutrality by 2025 (U-M Planet Blue, 2021). Analyses comprising the PCCN report were conducted by Internal Analysis Teams (IATs) on topics pertinent to U-M's net-zero pathways.

As part of the Carbon Accounting Modeling Project (CAMP) IAT, a baseline Scope 3 Purchased Goods & Services (PGS) emissions range for the 2018 fiscal year (FY 2018) was computed using the Carnegie Mellon Economic Input-Output Life Cycle Assessment (EIO-LCA) footprinting tool (Keoleian et al., 2021, Carnegie Mellon Green Design Institute, 2008). Their methods yielded a range of emissions by applying a lower-end emissions factor ('travel and services' – 147 tCO_{2e}/\$1M) and upper-end emissions factor ('paints and coatings' – 680 tCO_{2e}/\$1M) to the total aggregate \$2.5 billion university spending for FY 2019 (U-M VP for Communications, 2020). This approach generated a footprint range of 290-1,360 kt CO_{2e} (See Figure 1). The CAMP report acknowledged that their Scope 3 PGS estimation methods represented overlap with different Scope 3 category emissions accounting performed by other IATs (See Appendix A for the full list of Scope 3 IAT descriptions). Furthermore, this approach lacked disaggregation of, and informed emissions factor selection for, university PGS spending.

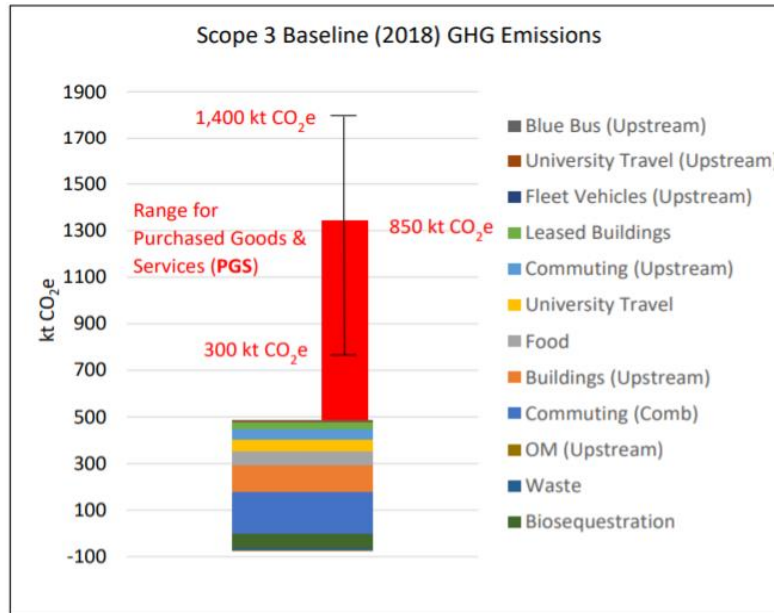


Figure 1: Scope 3 baseline GHG emissions, by activity, with an estimated range for PGS (Keoleian et al., 2021)

In 2010, Jolliet et al. performed the university’s first carbon accounting footprinting project for \$1.7 billion in U-M PGS spending and energy consumption during FY 2009 (Jolliet et al., 2010). The scope of this project resembled that of the CAMP report as it estimated Scope 1, 2 and 3 emissions for the university. However, with higher purchasing level resolution than the CAMP report, they assessed the individual footprints of thirteen spending ‘account groups’ based on data provided by U-M Procurement Services (U-M PS). Each account group was made of accounts that, on the basis of its U-M PS description, were assigned one corresponding emissions factor from the USA Input Output Database 98 library in SimaPro. Emissions of on-campus fossil fuel combustion and purchased electricity use-phase were calculated using the Ecoinvent 2.0 Database to produce a footprint of 1,700 kt CO₂e.

Both U-M Scope 3 PGS footprinting efforts lack representativeness, specifically among the data they employed. The Jolliet et al. input-output tool drew data from 1998 for 2009 spending, while the Carnegie Mellon EIO-LCA method used in the CAMP report relied on industry data from 2002 (CMU, n.d.-a). Footprinting values in both cases contained temporal/technological mismatches as supply chains and environmental flows in the national economy changed over time. In their review of published third-party mandatory and voluntary CCP data, Busch et al., 2022 have identified high correlation of Scope 1 and 2 estimates between different studies relative to Scope 3 (Busch et al., 2022). They also hypothesized that with continued practice of Scope 3 estimation, footprinting practitioners would see increased consistency between their results over time. However, the opposite was observed, with Scope 3 estimates growing inconsistent in subsequent results for both voluntary and mandatory data from both primary and third-party studies. Busch et al. conclude that continued practice of standardized estimation methods alongside thorough transparency mark best practices for estimation of Scope 3 footprinting, despite these inconsistencies (ibid.).

2. Institutional Architecture

2.1 Locations and Leadership

The University of Michigan is hierarchically structured, consisting of an executive office that oversees U-M Flint, U-M Dearborn, and a cast of directors, advisors, and departmental vice presidents responsible for the various divisions that make up the Ann Arbor campus. (See Appendix B for the U-M Office of the President Organization Chart) (University of Michigan, 2020).

2.2 Procurement Services

All U-M purchasing information funnels into the Ann Arbor Procurement Services database, where individual transactions are categorized according to a set of accounts structured for federal reporting compliance. Similarly purposed accounts are clustered into ‘account groups’ and, when added, constitute net spending (See Table 1). The U-M Financial Operations unit is responsible for account group design and management.

Predating the Joliet et al. (2010) study, U-M Procurement Services enshrined the *Code of Conduct for University of Michigan Vendors* (U-M Procurement, 2005) under the University of Michigan President’s Task Force on Purchasing Ethics and Policies. The Code of Conduct promulgates an assortment of ‘Primary’ or ‘Preferential’ Standards with which vendors are expected, or desired, to demonstrate compliance. ‘Environmental Protection’ is listed as a Preferential Standard but lacks explicit guidance on greenhouse gas emissions (ibid.).

3. Methods

3.1 Emissions Footprinting

In accordance with Minx et al., 2009, this project defines carbon footprint as the total emissions (direct, indirect, or both) associated with a clearly distinguished scope or boundary of consumption (Minx et al., 2009). Key greenhouse gases responsible for this consumption will be converted into a common metric of carbon dioxide equivalent (CO_{2e}) using global warming potential (GWP) conversion factors that represent each gas’ specific capacity to trap solar radiation in the atmosphere over a 100-year time horizon (GWP-100). GWP-100 values provided in IPCC AR5 were used in this study (IPCC, 2015).

Process-level life cycle assessments (process LCA) identifies the resource inputs and environmental outputs along the life cycle stages of specific good and service systems using primary process data from producers (CMU, n.d.-b). The International Standards Organization (ISO) created ISO 14040 to standardize process LCA practices across industries (ISO, 2006). Communicating the LCA results of specific products and services is increasingly demanded in global markets to inform purchasing on the basis of environmental performance. To homogenize reporting practices, ISO developed the ISO 14024, 14021 and 14025 standards for types I (“environmental labelling”), type II (“self-declared environmental claims”), and type III (“environmental labels and declarations”), respectively (ISO, 2018; ISO, 2020; ISO 2021). Type III, or environmental product declarations, follow established guidelines of environmental

performance data categories, and delineate product category rules (PCRs) that enable comparability among substitute commodities or services on the market (Del Borghi, 2013).

In the absence of process LCA data, input-output (I-O) models can be used to estimate resource use and environmental burdens associated with spending in sectors, or on commodities, using financial data. Where process LCA footprinting is a measure of direct impact profiles from specific products or services with high representativeness, I-O footprinting estimates only the rough scale of impact for a set amount of consumption. The economic input-output (EIO) model is a tool developed and used among global institutions such as the United States Bureau of Economic Analysis (BEA) for national accounting purposes (U.S. Bureau of Economic Analysis, 2022). EIO models are matrices presented in a sector-by-sector or sector-by-commodity format that detail the economic relationships between sectors and commodities, expressed in units of currency exchanged to produce value-added goods and services (Leontief, 1951, Di Matteo, 2018). Environmentally-extended input-output (EEIO) models adapt EIO tools using sectoral emissions data, among other environmental burdens, to reflect the footprints of supply chains (Matthews et al., 2014). One fundamental limitation of EIOs is that they aggregate industries or commodities into singular category profiles (ibid.). For example, in the United States different laptop computer producers are bundled under the North American Industry Classification Code (NAICS) 334111 or “Electronic Computer Manufacturing”. This makes distinguishing relative impacts between supplier options impossible without process LCA data. Nevertheless, a key benefit of EEIO footprinting is that no clear boundaries of analysis need be drawn, making them useful for large-scale footprinting projects (Matthews et al., 2014, Minx et al., 2009). Publicly available EEIO models for the United States economy include the Environmental Protection Agency’s (EPA’s) *United States Environmentally-Extended Input-Output Version 2.0* (USEEIO v2.0) model and the Carnegie Mellon Economic *Input-Output Life Cycle Assessment* (EIO-LCA) used in the CAMP report (Yang et al., 2017, CMU, n.d.).

The application hierarchy of footprinting methods for PGS outlined in the GHG Protocol *Technical Guidance for Calculating Scope 3 Emissions* is 1) supplier-specific method (process-LCA); 2) hybrid method (supplier-specific data with EEIO use to supplement data gaps); 3) average-data method (process emissions per unit mass or product consumed); or 4) spend-based method (EEIO) (Barrow et al., 2015). As will be discussed, the quality of University of Michigan procurement data made the spend-based approach appropriate for this study.

Another common shortcoming among EEIOs is that they are constrained by the release of economic input-output data and in the United States, the BEA is responsible for their development. While BEA ‘summary’ level I-O tables are released yearly (consisting of 71 aggregated NAICS categories), ‘detail’ I-O tables (405 disaggregated NAICS categories) lag several years after the FYs they represent (U.S. Bureau of Economic Analysis, 2022). The USEEIO uses I-O data from 2012 and generates commodity-based environmental burden figures based on the 2012 USD (Yang et al., 2017). Similarly, the EIO-LCA released their *Benchmark Producer Price* model in 2002 (CMU, n.d.-a). (See Appendix C for an example of summary- and detail-level EEIO sector categories). This publication schedule, in tandem with the sectoral aggregation quality of EIOs, thus increase the uncertainty of footprint representativeness.

In 2019, Ingwersen & Li published the EPA’s *Supply Chain Greenhouse Gas Emissions Factors for US Industries and Commodities*, which was amended to v1.1 in 2022 (Ingwersen & Li, 2020). Generated using the USEEIO, Ingwersen & Li designed the tool for spend-based emissions footprinting applications. The model presents a series of summary- and detail-level emission factors for both industry sectors and commodities for years in the period 2010-2016.

Each sector and commodity is accompanied by cradle-to-shelf, cradle-to-gate, and gate-to-shelf supply chain emissions factors (SEFs) broken down by 1) carbon dioxide; 2) methane; 3) nitrous oxide; and 4) other GHGs aggregated in CO₂e using AR4 GWP-100 factors. All emissions factors are adjusted for 2018 purchaser price, where the EIO-LCA and USEEIO v2.0 are both in producer price from 2002 and 2012, respectively. An assumption built into the Ingwersen & Li model is that all production and transportation occurs in the United States (Ingwersen & Li, 2020). For reasons of temporal representativeness, and expression of emissions factors in purchaser dollars, we selected this EEIO-derived tool for our project. See Appendix D for a complete list of all NAICS codes comprising the SEF tool.

3.2 Campus Collaboration

The U-M Office of Campus Sustainability facilitated a formal collaboration between our project team and U-M Procurement Services (U-M PS). With the dedicated support of U-M PS, the Scope 3 PGS footprinting team was able to establish open communication to tailor and specify data needs for the project. Establishing such collaborative relationships was noted as crucial by Perlman (2020) in their footprinting of PGS for the Massachusetts Institute of Technology (Perlman, 2020).

3.3 Procurement Data Structure

To understand opportunities for spending disaggregation, we requested from U-M PS a sample dataset with all available data fields describing individual transactions (See Appendix E for full list of U-M PS data fields and descriptions). Analysis of the sample and consultation with U-M PS indicated that the two dominant purchasing methods available to staff and faculty include:

3.3.1 Purchase Orders

Purchase Orders (POs) are conducted over M-Marketsite, the university's centralized, web-based catalog ordering platform. On M-Marketsite, users are able to navigate products offered by strategic suppliers whom the university has entered into contracts with to consolidate purchases and maximize savings. Descriptive data for transactions is common in POs as vendors generate and share data through the relationships and communication of their U-M contracts. The U-M PS system includes a United Nations Standard Products and Services Codes (UNSPSC) data field. UNSPSC codes are standardized classifications for commodities and services commonly used in e-commerce (United Nations Development Programme, n.d.) and mimic NAICS structures (See Appendix F for an example UNSPSC code hierarchy). However, these codes were underutilized, resulting in the low quality and consistency of these data.

3.3.2 P-Cards

Purchasing cards (P-Cards) are charge cards issued to university faculty and staff. Originally designed for university travel, they are now most commonly used for rapid purchase with vendors often existing outside the centralized procurement channel of M-Marketsite. Given the diversity of procurement channels P-Cards offer, the program's management by JPMorgan-Chase, and the low resolution of purchases inherent to charge

cards, data quality for emissions estimation (e.g., item descriptions which would allow for accurate assignment of industry sectors) among P-Card transactions is low.

The data format provided by PS was one in which the General Ledger (total fiscal year spending) was broken down into 17 ‘Account Groups’ (Table 1). Each account group was further composed of ‘Accounts’ (see example breakdown in Appendix G). Each account had an accompanying description for the types of purchases it contained. While analysis of precise purchases is desirable for footprint representativeness, a substantial portion of overall spending was conducted using P-Cards. Because the procurement dataset lacked essential data for item-level PGS footprinting and exhibited inadequate UNSPSC data quality, our footprinting estimation occurs at the account level.

Table 1: Full List of Account Groups and Corresponding FY 2020 Spending

Account Group	Spend (dollars)
Laboratory Research Supplies	\$1,032,844,761
General Expenses	\$911,737,916
Plant Operation and Maintenance	\$413,761,550
Insurance Expenses	\$228,509,593
Medical Expenses	\$159,624,150
Computing Services and Supplies	\$146,928,392
Travel, Hosting, and Transport	\$127,203,181
Fees and Services	\$109,352,768
Space Rental and Renovations	\$61,005,563
Communications	\$31,040,154
Use Charge Service Facilities	\$15,665,146
Payments to Auxiliary Activities	\$5,777,799
Student Loans	-\$500
Transfers and Distributions	-\$16,591
Medical	-\$129,448
Internal Rebill	-\$134,547,098
Recharge Revenue	-\$560,973,255

3.4 Determining Scope

The CAMP IAT relied on an aggregated \$2.5 billion dollar FY 2019 line item as a placeholder for PGS spending, while lacking clear exploration into purchasing categories, or financial accounting procedures contained within that figure. Table 2 lists all account groups used by the University and indicates those included in the analysis. The scope of our PGS footprinting was determined by isolating service & good in-flows to the university, and excluding non-market expenditures from the analysis. Within each included account group, specific accounts were excluded from the analysis on the basis of whether they were non-market expenditures. Non-market accounts included categories like utility distribution rebill or recharge revenue, while others misrepresented the true cost of PGS in the form of savings accounts. U-M PS and the U-M Financial Operations office aided in the process of delineating market and non-market accounts. For a full list of in-scope accounts, see Appendix H. Where the reported figure for university spending in FY 2020 totaled \$2.574B, our disaggregation and account elimination procedure reached approximately \$2.809B (U-M VP for Communications, 2020). This 9% increase in the FY line item is due to the exclusion of a savings account which discounted the aggregate market value of goods from the ‘Laboratory Research Supplies’ account group by

approximately \$250 million. This is a reminder that the line item produced by U-M Financial Operations is an accounting statement, not an indicator of market spending.

Table 2: Account Groups Included in U-M Scope 3 PGS Footprinting Analysis

Account Group	Included	Excluded
Communications	X	
Computing Services and Supplies	X	
Fees and Services	X	
General Expenses	X	
Insurance Expenses	X	
Internal Rebill		X
Laboratory Research Supplies	X	
Medical	X	
Medical Expenses	X	
Plant Operation and Maintenance	X	
Payments to Auxiliary Activities		X
Recharge Revenue		X
Space Rental and Renovations	X	
Student Loans		X
Transfers and Distributions		X
Travel, Hosting, and Transport	X	
Use Charge Service Facilities		X

Another important consideration when defining scope was whether to footprint other GHG Protocol Scope 3 categories that are available in the procurement data. ‘Purchased goods & services’ is its own Scope 3 category and can have overlap with other GHG Protocol Scope 3 services and goods (see Table 3 for a full list of GHG Protocol Scope 3 Emissions Categories). Although many Scope 3 categories had already been inventoried by the CAMP, Food, Commuting and University-Sponsored Travel IATs, we decided to estimate emissions from business travel and food in our analysis using EEIO footprinting. The IAT studies in these categories relied on extrapolation methods to represent entire FYs based on shorter timeframes of study. Food footprinting had also been performed using ingredient masses according to the average-data footprinting method.

Table 3: GHG Protocol Upstream & Downstream Scope 3 Emissions Categories

	Scope 3 Category	Analyzed by PCCN IATs	Analyzed by U-M PGS
Upstream	Purchased goods & services	X	X
	Capital goods		
	Other fuel- and energy-related activities	X	
	Upstream transportation & distribution	X	X
	Waste generated in operations		
	Business travel	X	X
	Employee commuting	X	
	Upstream leased assets		
Downstream	Downstream transportation & distribution		
	Processing of sold products		
	Use of sold products		
	End-of-life treatment of sold products		
	Downstream leased assets		
	Franchises		

3.5 Assignment of Emission Factors & Emissions Calculations

The *Supply Chain Greenhouse Gas Emissions Factors for US Industries and Commodities* tool organized both commodity and sector SEFs according to an adapted set of North American Industry Classification System (NAICS) codes used by the BEA in their EIO models. NAICS codes are used by the U.S. Federal Government to classify businesses according to their function. U-M PS has developed descriptions instructing the types of purchases appropriate for every account. Using account descriptions, we assigned corresponding emission factors to accounts based on NAICS descriptions. A link to the spreadsheet containing all included accounts and their assigned emission factors can be found in Appendix I. Assumptions were validated by a second round of account industry assignments with account responsibilities reversed between the two research team members. Differences between the two rounds of assignments were reconciled by the two researchers. To develop a final set of footprint estimates, we selected the lowest- and highest-impact SEFs from the list of assumptions for each account to establish emissions ranges. Table 4 provides a sample account with its corresponding SEF assignments. As seen with this example, a wide range of emissions was produced for the ‘Bakery’ account (80-667 t CO₂e).

Table 4: Example Account-SEF Assignment Structure

U-M Account	BEA NAICS Code	Industry-Level NAICS Title	GWP 100 (kg CO ₂ e/\$)	Account Spending (\$)	Emissions (t)
Bakery	311210	Flour milling and malt manufacturing	1.399	476,892	667
Bakery	311810	Bread and bakery product manufacturing	0.753	476,892	359
Bakery	311300	Sugar and confectionery product manufacturing	0.624	476,892	298
Bakery	722A00	All other food and drinking places	0.168	476,892	80

3.6 SEF Assignment Uncertainty

Confidence ratings were assigned to each account from a four-letter scale depending on the level of detail contained within each account description (See Table 5 for the confidence rating scale). Using account confidence ratings and corresponding portion of spend for each account,

weighted confidence ratings were summarized at the account group level (See Table 6 for weighted confidence ratings by account group). Dominant spending account groups like Laboratory Research Supplies (46% of total spend analyzed) and General Expenses (25% of total spend analyzed) saw weighted confidence scores of ‘B’ and ‘C’, respectively.

Table 5: Confidence Rating Criteria Breakdown

Confidence Rating	Criteria:
A	Goods/services can be clearly mapped to industries
B	Relevant industries can be mapped to goods/services with fair confidence
C	Account lacks detail about goods/services procured
D	Uncharacterizable data

Table 6: Weighted Confidence Ratings by Account Group

Account Group:	Fraction of Total Spend Analyzed:	Weighted Confidence Rating:
Laboratory Research Supplies	46%	B
General Expenses	23%	C
Plant Operation and Maintenance	8%	B
Medical Expenses	6%	B
Computing Services and Supplies	5%	A
Insurance Expenses	5%	B
Travel, Hosting, and Transportation	3%	B
Fees and Services	2%	D
Space Rental and Renovation	2%	B
Communications	1%	B

The formula used for calculating the emissions estimates of each account was a simple multiplication of dollars spent in the account by the emission factor (kg CO₂e per \$) for the assigned relevant sector. Therefore, total emissions is sensitive to dollars spent, emission factors, or dollars spent and emission factors. All market accounts that possessed negative dollar sums were excluded from the study as they would result in negative emissions from this calculation. An example footprinting calculation corresponding to the first row of Table 4 is shown in Equation 1.

Equation 1: Emissions Footprint of U-M Bakery Account with ‘Flour Milling and Malt Manufacturing’ Supply Chain Emissions Factor

$$\$476,982 \times 1.399 \text{ kg CO}_2\text{e}/\$ = 667 \text{ kg CO}_2\text{e}/\$$$

Averages for each account were computed and then totaled for footprints at the account group level. The variance for each account was totaled for each account group to then calculate account group standard deviations.

Due to the EPA SEF tool representing sectoral emission factors in 2018 dollars, the Scope 3 PGS team accounted for inflation and interest by converting 2020 USD from FY 2020 to 2018 USD using the Bureau of Labor Statistics' (BLS) Consumer Price Index Research Series (CPI-U-RS) (U.S. Census Bureau, 2020).

4. Results

4.1 Key Findings

We estimated an SEF assignment emissions footprint average of 673 kt CO₂e, and an emissions footprint range with a lower bound of 373 kt CO₂e and an upper bound of 1,259 kt CO₂e. The PCCN CAMP IAT originally estimated an emissions footprint range of 290-1,360 kt CO₂e. As in the CAMP estimates, our wide footprint range reflects the significant uncertainty in the mapping of university spending to EEIO SEF categories. The upper bound estimate in the CAMP report stands about 100 kt CO₂e higher than our estimate, while the lower-bound estimate is around 60 kt CO₂e lower. The CAMP IAT calculated a U-M Scope 1 and 2 emission footprint of approximately 750 kt CO₂e. With comparison to the PGS footprint bounds developed in this project, an upper bound scenario would see PGS emissions almost tripling all inventoried university emissions. A lower bound scenario would still see nearly a fifty percent increase in institutional emissions. Finally, an SEF assignment average footprint scenario sees emissions almost doubling.

Regarding uncertainty in the model, in many cases multiple SEFs were assigned to a spending account because researchers were unable to determine specific spending activities within them. Averages were taken from SEF assignments for each account, alongside their respective standard deviations to indicate the range in SEF emissions intensities assigned. Account averages were summed to produce a total assignment SEF emissions footprint average of 673 kt CO₂e. Estimated bounds are shown in Figures 2 and 3, with the average included in Figure 3.

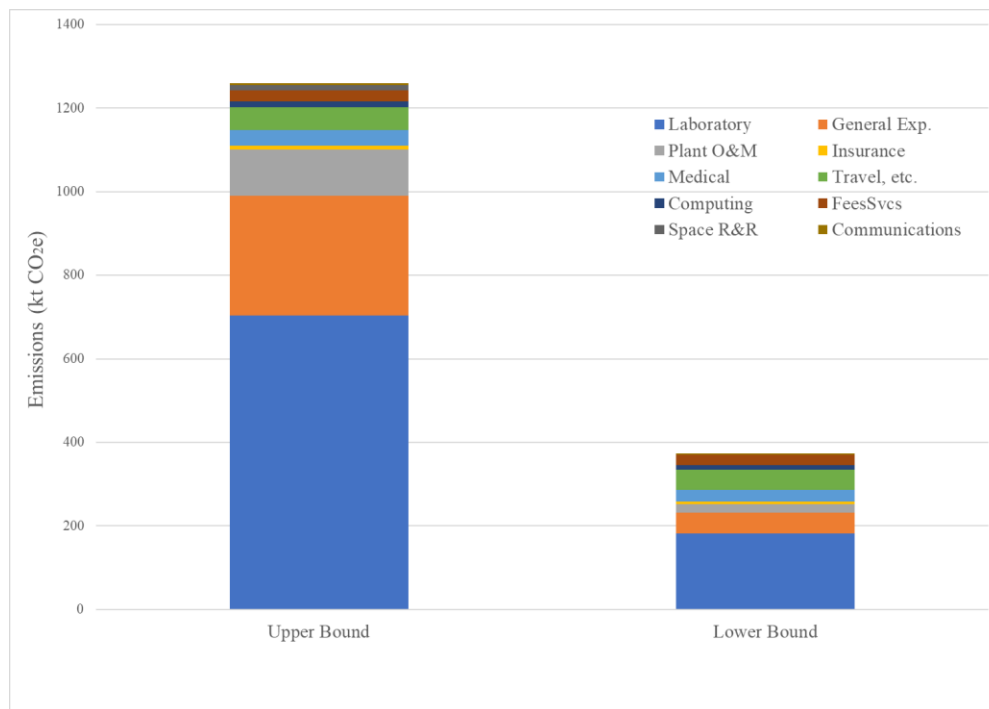


Figure 2: FY 2020 Scope 3 PGS Emissions Footprint Range (Upper & Lower Bound)

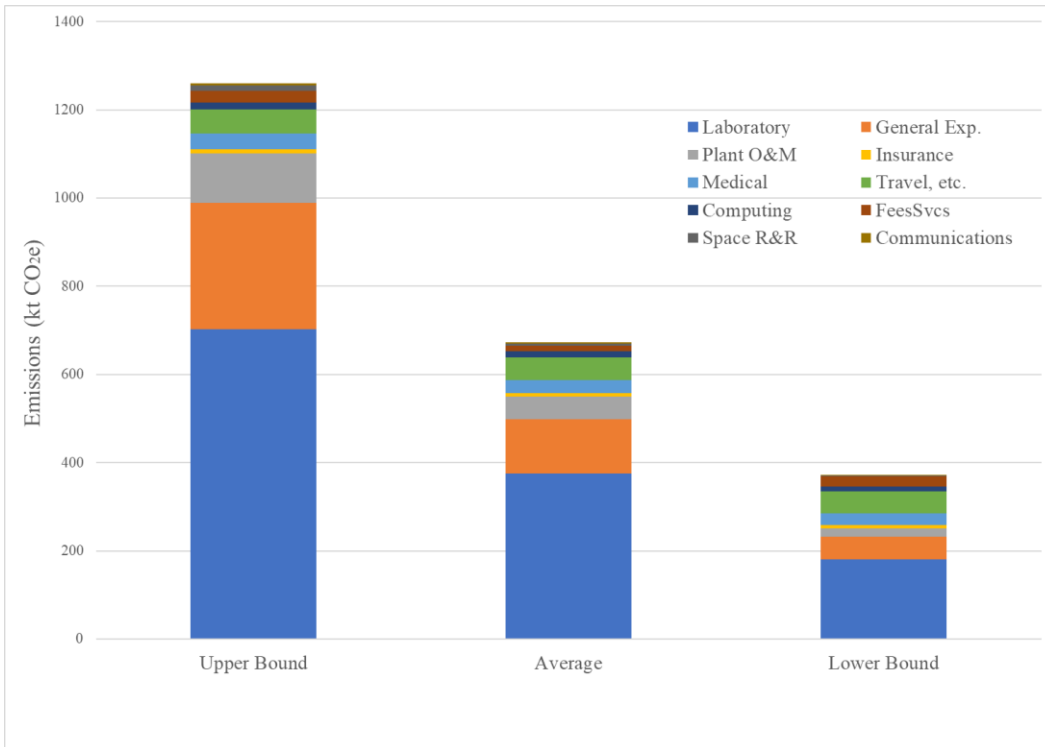


Figure 3: FY 2020 Scope 3 PGS Footprint Range with SEF Assignment Averages Total

Propagation of uncertainty was calculated at the account group level using the standard deviation statistics from their accounts. Figure 4 illustrates average emissions for each account group, with error bars representing the standard deviation. Table 7 details all upper- and lower-bound emissions estimates for the account groups included in the project scope.

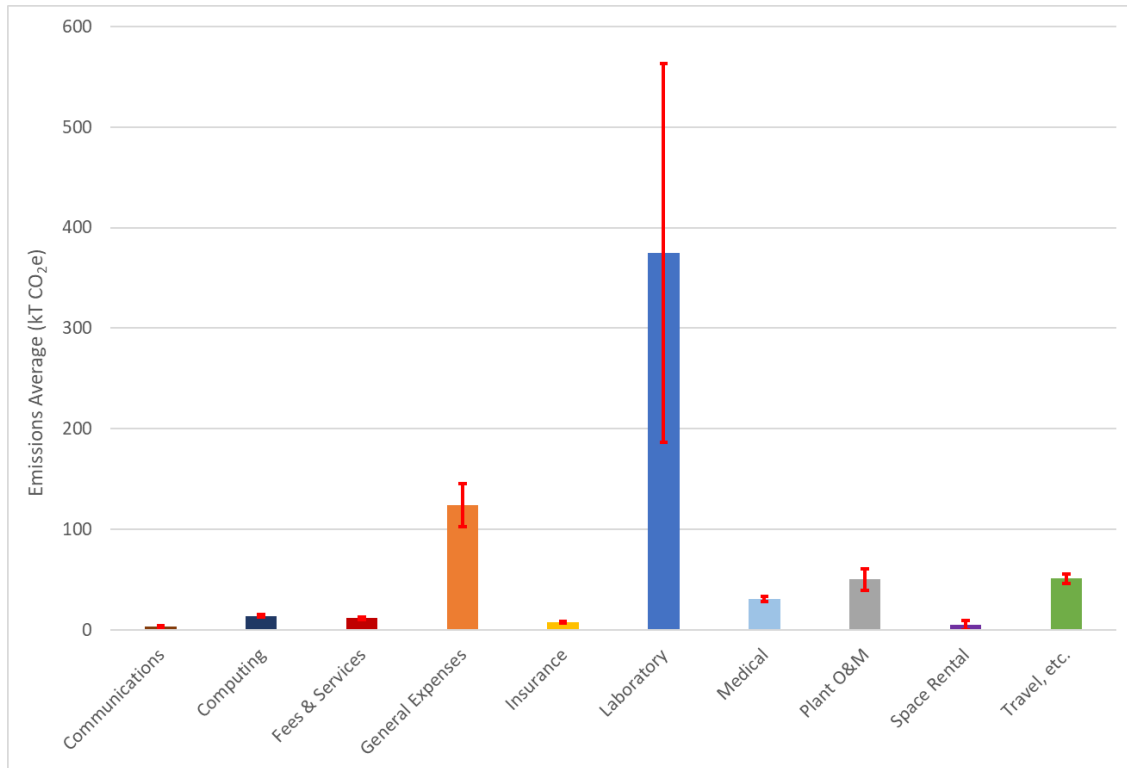


Figure 4: FY 2020 Scope 3 PGS SEF Assignment Emissions Footprint Averages by Account & Their Standard Deviations (Red Bars)

Table 7: FY 2020 Upper & Lower Emissions Estimates for all Analyzed Account Groups, sorted by upper estimate

Account Group	Upper Estimate (kt CO ₂ e)	Lower Estimate (kt CO ₂ e)
Laboratory Research Supplies	703.2	181.5
General Expenses	286.5	51.0
Plant Operations & Maintenance	111.6	19.2
Travel, Hosting & Transport	54.1	49.0
Medical Expenses	36.9	27.6
Fees & Services	26.5	24.1
Computing Services & Supplies	15.5	10.7
Space Rental & Renovations	12.5	0.4
Insurance Expenses	9.0	6.7
Communications	4.1	2.9
Total	1259.9	373.1

4.2 High-Impact Account Groups

Three account groups stood out in the final estimate as ‘high-impact’, namely Laboratory Research Supplies (LRS), General Expenses (GE), Plant Operations & Maintenance (POM).

4.2.1 Laboratory Research Supplies:

LRS saw the highest upper- and lower-bound emissions estimates of all account groups analyzed in the study. The ‘Pharmaceuticals’ account possessed a proportionately equal, majority share of both total spend and emissions footprint in LRS, indicating that emissions are driven by spending for this account. ‘Pharmaceuticals’ encompassed pharmaceutical spending for research and by the U-M medical systems. The account ‘Surgical/Medical Supplies’ saw a reduction in its emissions footprint relative to its spend, driven by an SEF lower than 1 kg CO₂e/\$. In addition to Laboratory Research Supplies standing as the largest contributor to emissions for the University, it is notable that the standard deviation associated with the account group is also the largest (see Figure 5), underlining the need for more granular data and tighter estimates in this category.

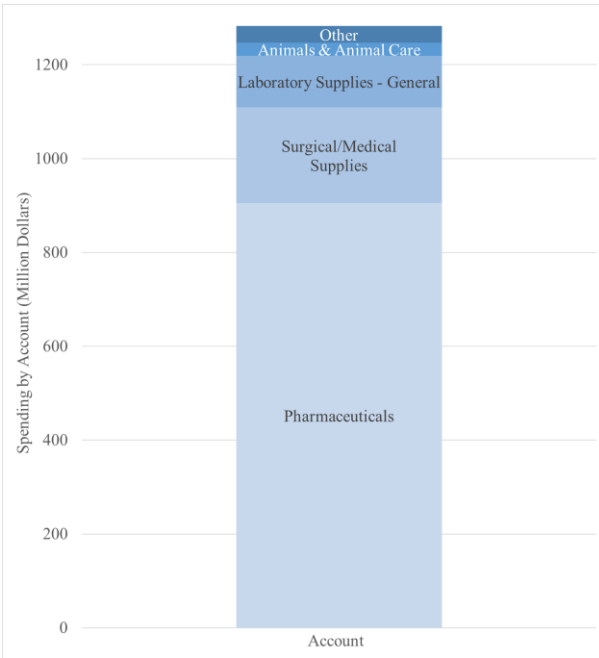


Figure 5: FY 2020 Laboratory Research Supplies Spending Breakdown by Account

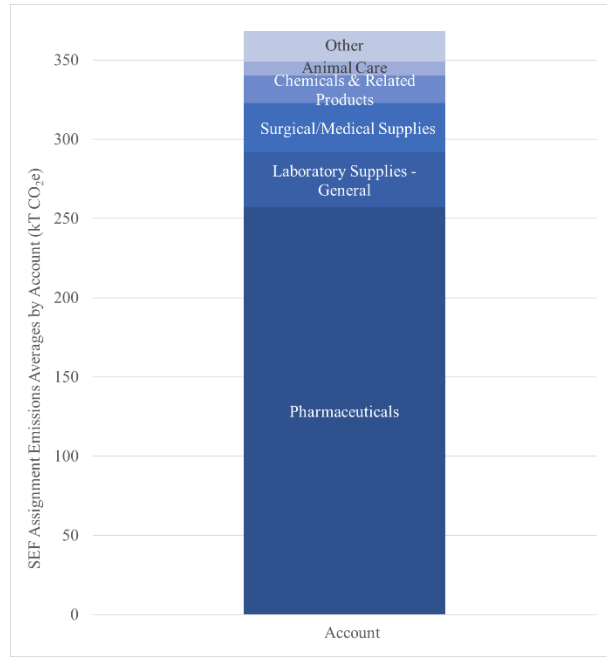


Figure 6: FY 2020 Laboratory Research Supplies SEF Assignment Emissions Footprint Averages by Account

4.2.2 General Expenses:

General Expenses (GE) was highly vague with regards to the types of spending its accounts contained, as reflected by its weighted confidence rating of ‘D’. The range of estimates for GE is the largest of all account groups, but could be better defined through higher-resolution data management structures, as is discussed in the section that follows.

One obvious result in the GE figures is the influence of emission factors on each account’s overall contribution to the GE emissions estimate. For example, while total spend on ‘Food & Food-Related’ – all accounts pertaining to food that we bundled together – was relatively small (Figure 7), these accounts dominated the GE emissions estimate with high emission factors (Figure 8).

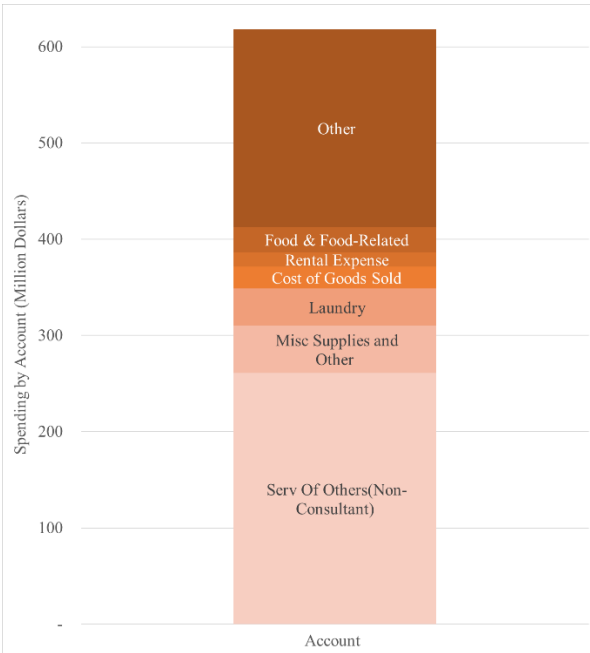


Figure 7: FY 2020 General Expenses Spending Breakdown by Account

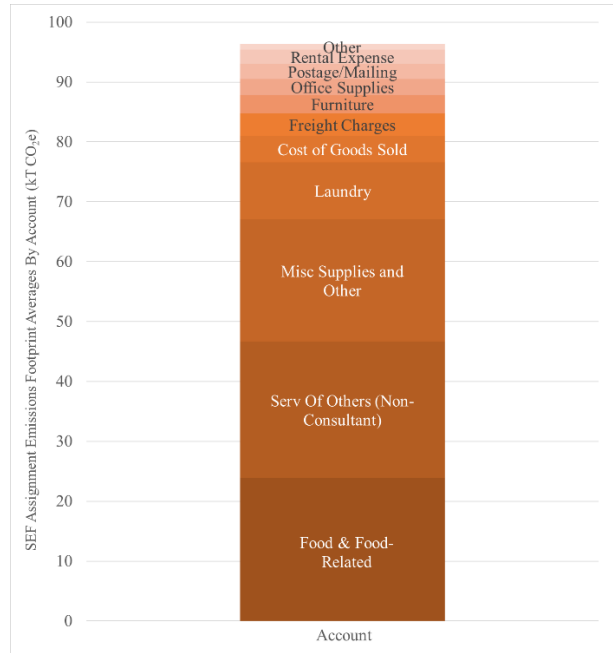


Figure 8: FY 2020 General Expenses SEF Assignment Emissions Footprint Averages by Account

4.2.3 Plant Operations & Maintenance:

The Plant Operations & Maintenance (POM) account group contained many accounts that overlapped with other GHG Scopes or IAT analyses (e.g., the inclusion of upstream emissions for electricity and fuel production by the CAMP project) and were thus excluded from our analysis. Of the accounts that remained in POM, maintenance and labor service categories dominated both in terms of spend and emissions estimate. As seen in LRS and GE, some accounts were larger in terms of spend, but were less significant in their contribution to overall emissions. For example, ‘Equipment Maintenance’ had the largest dollar amount attached, but came third in terms of emissions, while ‘Building Maintenance’ (second largest dollar amount) dominated emissions, indicating that higher emissions factors were assigned to the account.

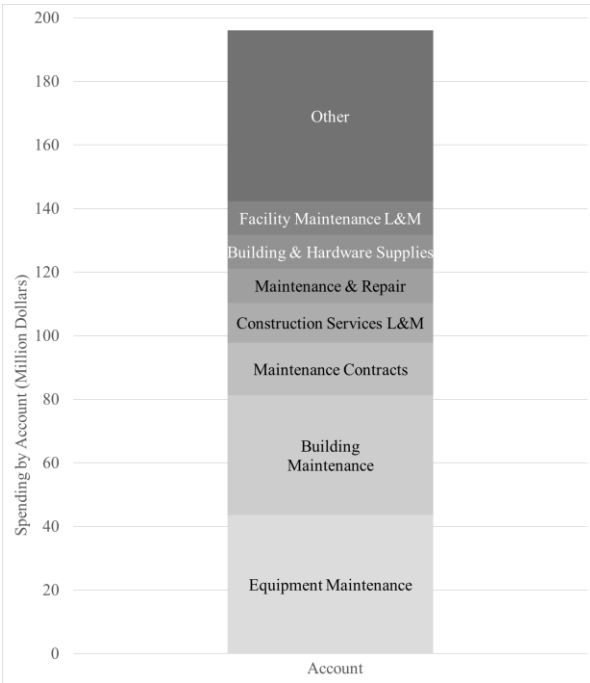


Figure 9: FY 2020 Plant Operations & Maintenance Spending Breakdown by Account

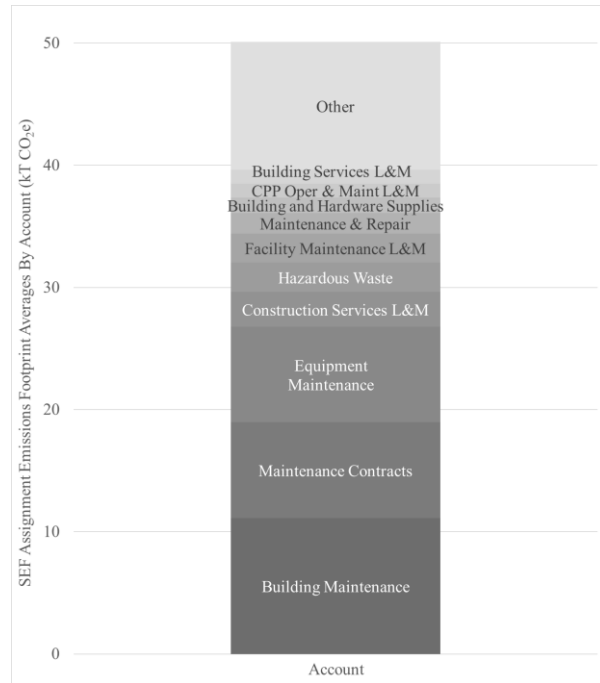


Figure 10: FY 2020 Plant Operations & Maintenance SEF Assignment Emissions Footprint Averages by Account

5. Discussion:

The project delivered on the goal of generating disaggregated estimates of GHG emissions for U-M Scope 3 PGS spending categories. Using a simplistic approach based on EEIO methods, there are two main ways for an institution to reduce its footprint: spend less (i.e., reduce consumption) and/or buy products with lower emissions factors. These limited approaches are driven by the inability of EEIO tools to distinguish vendors by their respective performance. EEIOs can only be used for upstream footprinting (emissions released during the production and supply chains of PGS), thereby creating blind spots for key life cycle stages that can drive impact (e.g., the use phase for electronics). The recommendations that follow cover both of these reduction options, but focus heavily on the latter, as there are many barriers that make it challenging for some university stakeholders to reduce consumption.

While the EEIO approach to institutional footprinting reveals where to direct efforts for emissions reductions, it does not instruct how to deliver reductions. The weighted confidence ratings generated in this study indicate a need for greater resolution on individual purchases to make more confident estimates. Ultimately, robust emissions tracking could be achieved using process-level data (e.g., EPDs) and methods, which would empower the university to differentiate environmental performance between vendors.

An example of how mapping purchases to EEIO categories can affect footprint is explored in the following exercise analyzing food. Spanning the dining system and U-M restaurants, U-M Dining organized all food spending for FY 2019 into the food-related categories provided in the EPA SEF tool used in this project.

6. Comparison of Spend-Based and Average-Data Footprinting Results for Food PGS Emissions

Accounts pertaining to food and food-related spending accompanied ambiguous descriptions for the purchases they contained, thereby necessitating broad assumptions for corresponding SEFs and expanding the range of emissions estimates for each account. For example, the emissions factors assigned to the ‘Food’ account range from ‘Grocery and related product wholesalers’ on the low end (0.232 kg CO₂e/\$), to ‘Grain Farming’ on the high end (4.146 kg CO₂e/\$). This difference in one order of magnitude, when multiplied by total spend in ‘Food’ (\$9,435,308), produces drastically different upper and lower bound estimates (2 kt CO₂e versus 39 kt CO₂e). Table 8 lays out the food-related categories in GE and the emissions estimates for each.

Table 8: FY 2020 Food-Related Account Spending and Emissions in the General Expenses Account Group

Account	Dollar amount	Upper Bound (kt CO ₂ e)	Lower Bound (kt CO ₂ e)	Average (kt CO ₂ e)
Bakery	\$476,892	0.4	0.1	0.3
Beverages	\$2,938,209	0.7	0.3	0.9
Dairy	\$2,289,948	3.9	0.3	2.8
Eggs/Butter/Cheese	\$224	0.0	0.0	0.0
Food	\$9,435,308	19.6	1.1	9.8
Food & Beverages	\$2,082,772	5.4	0.3	2.0
Food Staples	\$2,345	0.0	0.0	0.0
Frozen Food	\$1,794,405	0.8	0.2	0.9
Meat	\$4,424,036	8.3	0.5	5.5
Produce	\$2,601,377	2.3	0.3	1.8
Refreshments	\$473,850	0.2	0.0	0.2
Total	\$26,519,371	41.6	3.1	24.1

We compared our analysis of food-related accounts with two other approaches to evaluate the impact of different methods of analysis, shown in Table 9. A data analyst for M-Dining provided us with a breakdown of spending based on a comprehensive list of food-related SEF industries we provided (M. Reid, Personal Communication, April 4, 2022). We then performed our footprinting calculations to obtain a supplementary food emissions estimate (Table 10). This scenario required no bounds or SEF averages to be taken because spending was clearly partitioned according to EEIO categories. The PCCN “Food at the University of Michigan” Internal Analysis Team performed a different type of analysis on food purchases using a mass-based approach, which generated a much larger emissions estimate than ours. Instead of analyzing food consumption throughout a twelve-month period, the PCCN Food IAT relied on menu data from the Fall 2019 semester, which was then extrapolated to an entire calendar year.

Table 9: FY 2019 M-Dining Purchasing Breakdown & Emissions

SEF Industry	Spend (\$)	Emissions (kt CO₂e)
Agriculture and forestry support	\$2,498.27	0.001
All other foods	\$687,427.19	0.481
Bread and other baked goods	\$1,620,611.78	0.522
Breakfast cereals	\$256,356.99	0.113
Cattle ranches and feedlots	\$1,109,378.66	4.319
Cheese	\$761,461.75	1.243
Coffee and tea	\$427,582.52	0.166
Cookies, crackers, pastas, and tortillas	\$308,727.86	0.217
Corn products	\$38,130.57	0.093
Dairies	\$534,009.06	1.844
Dry, condensed, and evaporated dairy	\$6,042.20	0.006
Flavored drink concentrates	\$33,436.24	0.014
Flours and malts	\$34,448.59	0.050
Fluid milk and butter	\$543,189.66	0.735
Fresh fruits and tree nuts	\$1,246,909.84	0.683
Fresh soybeans, canola, flaxseeds, and other oilseeds	\$206,016.38	0.265
Fresh vegetables, melons, and potatoes	\$1,378,148.89	0.788
Fresh wheat, corn, rice, and other grains	\$160,153.76	0.645
Frozen food	\$579,421.41	0.487
Fruit and vegetable preservation	\$525,424.03	0.256
Greenhouse crops, mushrooms, nurseries, and flowers	\$101,635.98	0.104
Ice cream and frozen desserts	\$95,514.88	0.056
Packaged meat (except poultry)	\$1,288,398.95	2.597
Packaged poultry	\$1,902,194.32	1.732
Refined vegetable, olive, and seed oils	\$156,816.36	0.237
Seafood	\$769,058.59	0.313
Seasonings and dressings	\$327,294.61	0.126
Snack foods	\$539,761.58	0.224
Soft drinks, bottled water, and ice	\$274,526.81	0.122
Soybean and other oilseed processing	\$81,559.04	0.105
Sugar, candy, and chocolate	\$414,255.37	0.220
Timber and raw forest products	\$1,635.46	0.000
Tobacco, cotton, sugarcane & other crops	\$172,455.65	0.021
Wineries and wine	\$14,062.20	0.003
Total	\$16,598,545.45	18.800

Table 10: Comparison of Approaches to Food Analysis & Corresponding Emissions Estimates

Study & Method	Emissions (kt CO₂e)
Scope 3 PGS Project EEIO Approach (Sum of SEF Averages for ‘Food & food-related’ Accounts)	24.1
U-M Food IAT Mass-Based Approach (Hoey et al., 2021)	60.9
Scope 3 PGS Project EEIO Approach w/ Detailed Data from M-Dining	18.8

These varying approaches and results demonstrate the need for consistency in emissions reporting across all U-M categories, which could be addressed by the recommendations provided in the following section. Both footprinting results using the EPA SEF tool yielded emissions estimates that were approximately one third that of the U-M PCCN Food IAT mass-based method for FY 2019. Compared to the ‘sum of SEF averages’ approach used in this study, detailed data from M-Dining lowered the overall footprint of ‘Food and Food-Related’ accounts between the two EEIO calculations. More accurate categorization of food spending reduced the uncertainty of SEF assignments and allowed for more representative emissions estimation. These results underscore the importance of better PGS categorization for improved tracking over time.

7. Recommendations for System Changes:

U-M should complement its streamlined procurement processes by implementing or adapting systems to allow for emissions tracking over time. Recommendations for system changes fall into two main categories: strategies for improved footprint tracking and strategies for emissions reductions.

7.1 Improved Emissions Tracking:

7.1.1 Mapping institutional purchasing account systems by groupings that match or correspond to EEIO emissions factors (e.g., NAICS, UNSPSC):

Exploring ways to map purchases to sector and commodity categories used in EEIOs (i.e., NAICS codes) will make for more accurate emission footprints. The procurement system would establish guidance for accurate assignment of purchases to accounts. Expanding university contracts would complement this change by providing high-detail data sharing, while eliminating the need for human intervention in the categorization process. Beyond environmental footprinting, mapping purchases to sector and commodity categories would allow U-M PS to support various activities or services pertaining to focused spending. For example, U-M PS could identify vendors who are both local *and* offer specific types of goods or services.

7.1.2 Encourage use of M-Marketsite and incorporate more detailed reporting of purchases when using P-Cards.

Encouraging use of M-Marketsite will not only facilitate the financial efficiencies made possible by U-M supplier partnerships, but also aid in enhancing data quality for a substantial portion of procured goods and services. P-Cards use should require comprehensive manual data entry measures from purchasers to mimic the quality of data provided by U-M strategic suppliers through M-Marketsite. To monitor data integrity, U-M procurement services should conduct specific outreach for units that continue to operate outside of expected standards.

7.1.3 Update mapping to emissions factors as accounts evolve.

As resolution on spending improves, update emission factors to reflect new understanding of their applicability to certain accounts. For example, emission factor assignments from this study should be re-assessed and amended based on their appropriateness to the purchases they characterize. Furthermore, as new tools supporting Scope 3 footprinting are available, U-M should allocate resources to support their use for future estimation.

7.2 Emissions Reductions:

7.2.1 Shift to acquiring environmental product declarations (EPDs) to make more sustainable purchasing decisions. EPDs provide the product-level information that the EEIO method lacks.

University procurement personnel should be prepared to manage EPDs as they increasingly accompany purchases. Adhering to reporting standards and vetting supplier information are essential for responsible and virtuous sustainable procurement. Ensuring that employees are able to interpret, compare, and act upon EPDs will empower U-M PS to deliver on their commitment to environmental protection as outlined in the *U-M Code of Conduct for University of Michigan Vendors*. The university can encourage data exchange pertaining to the environmental performance of their products and services from its vendors. EPDs provide data that are of process-LCA quality, thereby empowering procurement to engage in comparative product decision making on the basis of supply chain environmental impact.

7.2.2 Conduct outreach to the wider community of institutions to develop a shared framework for sustainable procurement practices.

U-M should enter a collaboration commitment with other higher-education institutions to establish reporting standards among universities to homogenize Scope 3 emissions tracking methods and training on the management of EPDs. Organizing and leveraging the buying power of collectives like the Ivy Plus consortium could also drive producer-end reporting of environmental performance for their products.

7.2.3 Explore use of existing asset management software to more efficiently use goods already procured by U-M.

Reduced purchasing generates absolute reductions in Scope 3 emissions for the University (among other externalities tied to goods & services). U-M should formally explore methods for extracting the greatest utility from the fewest purchases. For example, eliminating redundant purchases

through existing asset management software would allow university personnel to share resources with one another.

8. Next Steps

8.1 Continue to Assess Capacities for Scope 3 PGS Footprinting

An increasing number of schools and institutions are setting goals and making commitments toward carbon neutrality. In the coming years, we expect this trend to continue, and the demand for Scope 3 emissions accounting tools will play a key role. U-M has the opportunity to be a leading institution in these efforts, and as such this model will require continued refinement and updating. As time passes, accounts in the procurement system may be added, eliminated or adjusted, and account-SEF assignments will need to be updated accordingly. Additionally, the SEF tool itself may evolve as industries continue to decarbonize and lower their emissions, so the emissions factors assigned must remain as up-to-date as available.

8.2 Maintain Collaborative Relationships in Support of Scope 3 PGS Footprinting

As U-M continues in efforts to decarbonize its PGS footprint, it will remain important for those students or staff studying these emissions to partner with Procurement Services and develop strategies for improved reporting and tracking.

8.3 Analyze Scope 3 PGS Footprinting by University Department Spending

Another step of analysis that this project did not take on was disaggregating emissions footprints for university departments. PS can provide purchasing data with an included field describing the department under which spending occurred. This would allow account spending to be disaggregated to compute upper- and lower-bound estimates for units within the university in efforts to identify high-impact spenders and to educate units about the carbon intensities of their activities.

9. Other Materials

As supplemental material to this report, the tool developed and employed by researchers on this project is available for use by other institutions. The following URL links to a folder containing resources developed for this study:

<https://drive.google.com/drive/folders/1Sye5LlnsycVyXamquwnO2x7k-b-ER02A?usp=sharing>

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Appendices:

Appendix A: IATs Involved in Scope 3 Topics for UM PCCN

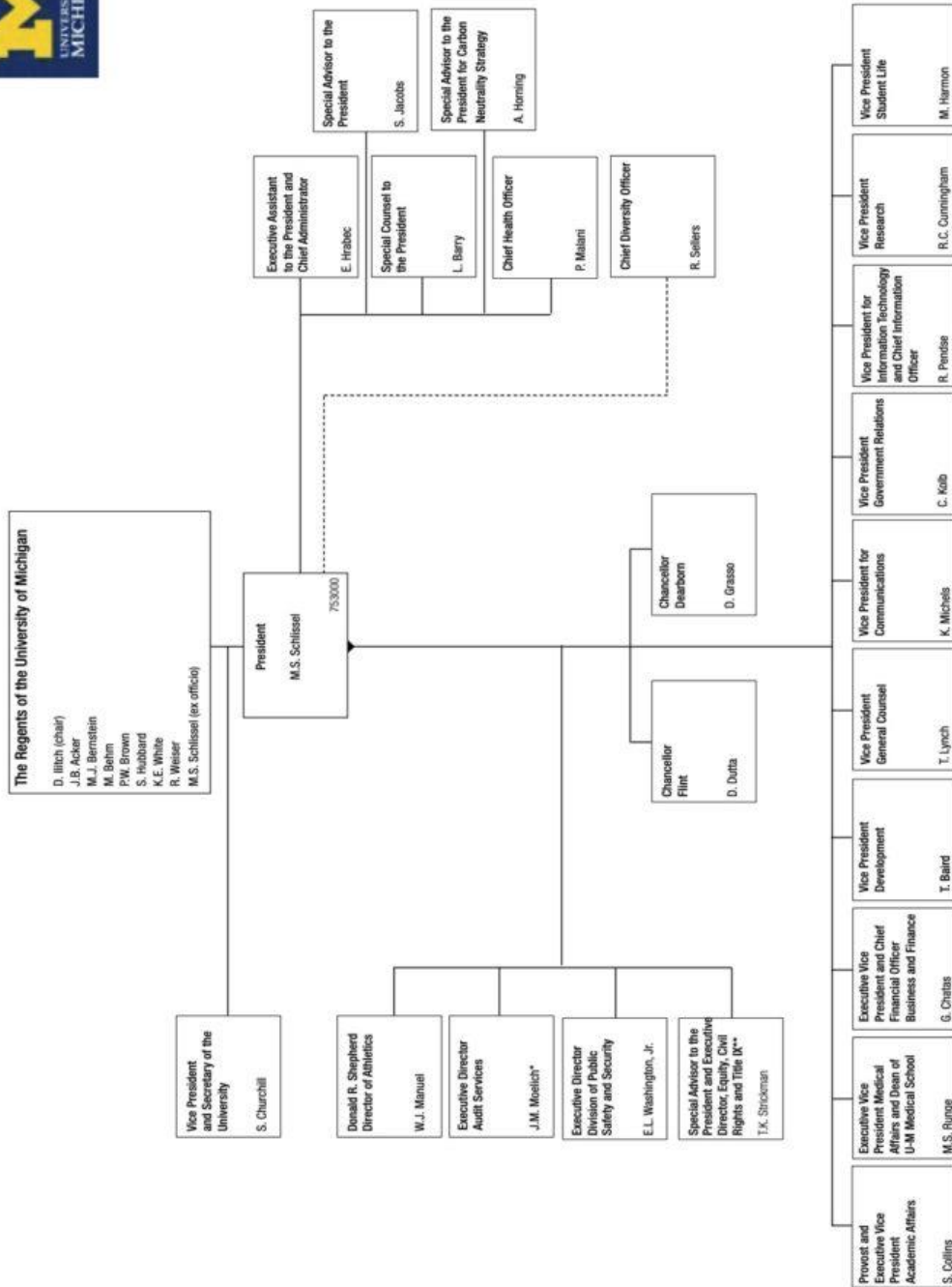
Internal Analysis Team	Goals of IAT:
Commuting	“[D]evelop an approach to measuring the carbon impact of the commute to the three University of Michigan campuses; will study approaches used by peer institutions to reducing the carbon impact of the commute and their effectiveness; will adapt promising approaches used elsewhere to the specific conditions of the UM campuses and their surrounding areas; and will develop prioritized recommendations for reducing the commute’s carbon footprint, including metrics and indicators for tracking progress.”
Carbon Accounting	“[Develop and implement] comprehensive carbon accounting model for the University of Michigan (Ann Arbor, Dearborn, and Flint campuses)...[Provide guidance and inform] the PCCN on emissions reductions strategies (including both technical and policy strategies) and their reduction potential over time, the development of carbon neutrality pathways and selection of neutrality goal years.”
Biosequestration	“The biosequestration team will evaluate and recommend optimal approaches for potential biological sequestration projects on and off-campus. The team defines its scope as having three overarching goals: 1) assessment of current UM landholdings; 2) categorization of land use on these properties; and 3) evaluation of land-use changes, where possible, that would maximize biosequestration potential. Additionally, the team will evaluate opportunities and challenges of different methods for changing land use, at multiple scales, to increase sequestration.”
University Food	“[Evaluate and recommend] approaches to decrease the GHG footprint associated with food consumption at U-M. Considerations may include sourcing, certifications, volume reduction, disposal, offsets, etc. The team’s work will focus attention on the role that dining services play in shaping the UM food system and will include mapping U-M’s dining services supply chains, existing data and current practices relevant to greenhouse gas emissions reductions across U-M dining services.

University-Sponsored Travel	“The university-sponsored travel team analysis will include six different goals: 1) to compile all published literature on travel footprints, the footprint of academic meetings, university and other travel policies, 2) to determine quantitatively the amount of University travel, 3) to understand why University personnel travel, 4) to propose ways to educate the University community to consider the carbon footprint when deciding whether travel is warranted and how to carry it out to minimize the carbon footprint, 5) to propose a system of offsets for travelers to use, and 6) to propose changes for travel-related data management systems.”
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Source: <https://sustainability.umich.edu/carbonneutrality/analysis-teams>

Appendix B: Office of the President Organization Chart

PRESIDENT



753000
OCTOBER 2021

* Also reports to the Board of Regents
**Also reports to the Provost and Executive Vice President Academic Affairs

Figure B1: Office of the President Organization Chart (University of Michigan, 2020)

Appendix C: Example of summary- and detail-level I-O categories

Provided below is an example comparison between summary- and detail-level I-O categories provided in the *Supply Chain Greenhouse Gas Emissions Factors for US Industries and Commodities* EEIO tool.

Table C1: Example Summary-Level I-O Categories

Commodity Code:	Commodity Name:	Substance:	Unit:	Supply Chain Emission Factors without Margins:	Margins of Supply Chain Emission Factors:	Supply Chain Emission Factors with Margins:
111CA	Farms	carbon dioxide	kg/2018 USD, purchaser price	0.467	0.046	0.513
		methane	kg/2018 USD, purchaser price	0.025	0	0.026
		nitrous oxide	kg/2018 USD, purchaser price	0.002	0	0.002
		other GHGs	kg CO2e/2018 USD, purchaser price	0.004	0	0.004

Example Summary Commodity 2016 BEA Summary Code 111CA: Farms emissions factors across all four GHG categories per USD spend on commodity

Table C2: Example Detail-Level I-O Categories

Commodity Code:	Commodity Name:	Substance:	Unit:	Supply Chain Emission Factors without Margins:	Margins of Supply Chain Emission Factors:	Supply Chain Emission Factors with Margins:
1111A0	Fresh soybeans, canola, flaxseeds, and other oilseeds	carbon dioxide	kg/2018 USD, purchaser price	0.323	0.066	0.389
		methane	kg/2018 USD, purchaser price	0.001	0.001	0.002
		nitrous oxide	kg/2018 USD, purchaser price	0.002	0	0.002
		other GHGs	kg CO2e/2018 USD, purchaser price	0.003	0	0.003

Example Detail Commodity 2016 BEA I-O Code 1111A0: Fresh soybeans, canola, flaxseeds, and other oilseeds emissions factors across all four GHG categories per USD spend on commodity

Appendix D: Full List of Industry Codes & Titles

Below are all industry BEA-adapted NAICS code titles used in the *Supply Chain Greenhouse Gas Emissions Factors for US Industries and Commodities* EEIO tool.

Industry Code	Industry Name
1111A0	Oilseed farming
1111B0	Grain farming
111200	Vegetable and melon farming
111300	Fruit and tree nut farming
111400	Greenhouse, nursery, and floriculture production
111900	Other crop farming
112120	Dairy cattle and milk production
1121A0	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming
112300	Poultry and egg production
112A00	Animal production, except cattle and poultry and eggs
113000	Forestry and logging
114000	Fishing, hunting and trapping
115000	Support activities for agriculture and forestry
211000	Oil and gas extraction
212100	Coal mining
212230	Copper, nickel, lead, and zinc mining
2122A0	Iron, gold, silver, and other metal ore mining
212310	Stone mining and quarrying
2123A0	Other nonmetallic mineral mining and quarrying
213111	Drilling oil and gas wells
21311A	Other support activities for mining
221100	Electric power generation, transmission, and distribution
221200	Natural gas distribution
221300	Water, sewage and other systems
230301	Nonresidential maintenance and repair
230302	Residential maintenance and repair
233210	Health care structures
233230	Manufacturing structures
233240	Power and communication structures
233262	Educational and vocational structures
2332A0	Office and commercial structures
2332C0	Transportation structures and highways and streets
2332D0	Other nonresidential structures
233411	Single-family residential structures
233412	Multifamily residential structures
2334A0	Other residential structures
311111	Dog and cat food manufacturing
311119	Other animal food manufacturing
311210	Flour milling and malt manufacturing
311221	Wet corn milling
311224	Soybean and other oilseed processing
311225	Fats and oils refining and blending
311230	Breakfast cereal manufacturing
311300	Sugar and confectionery product manufacturing
311410	Frozen food manufacturing
311420	Fruit and vegetable canning, pickling, and drying
311513	Cheese manufacturing
311514	Dry, condensed, and evaporated dairy product manufacturing
31151A	Fluid milk and butter manufacturing
311520	Ice cream and frozen dessert manufacturing
311615	Poultry processing
31161A	Animal (except poultry) slaughtering, rendering, and processing
311700	Seafood product preparation and packaging
311810	Bread and bakery product manufacturing
3118A0	Cookie, cracker, pasta, and tortilla manufacturing
311910	Snack food manufacturing
311920	Coffee and tea manufacturing
311930	Flavoring syrup and concentrate manufacturing
311940	Seasoning and dressing manufacturing
311990	All other food manufacturing
312110	Soft drink and ice manufacturing

312120	Breweries
312130	Wineries
312140	Distilleries
312200	Tobacco product manufacturing
313100	Fiber, yarn, and thread mills
313200	Fabric mills
313300	Textile and fabric finishing and fabric coating mills
314110	Carpet and rug mills
314120	Curtain and linen mills
314900	Other textile product mills
315000	Apparel manufacturing
316000	Leather and allied product manufacturing
321100	Sawmills and wood preservation
321200	Veneer, plywood, and engineered wood product manufacturing
321910	Millwork
3219A0	All other wood product manufacturing
322110	Pulp mills
322120	Paper mills
322130	Paperboard mills
322210	Paperboard container manufacturing
322220	Paper Bag and Coated and Treated Paper Manufacturing
322230	Stationery product manufacturing
322291	Sanitary paper product manufacturing
322299	All other converted paper product manufacturing
323110	Printing
323120	Support activities for printing
324110	Petroleum refineries
324121	Asphalt paving mixture and block manufacturing
324122	Asphalt shingle and coating materials manufacturing
324190	Other petroleum and coal products manufacturing
325110	Petrochemical manufacturing
325120	Industrial gas manufacturing
325130	Synthetic dye and pigment manufacturing
325180	Other Basic Inorganic Chemical Manufacturing
325190	Other basic organic chemical manufacturing
325211	Plastics material and resin manufacturing
3252A0	Synthetic rubber and artificial and synthetic fibers and filaments manufacturing
325310	Fertilizer manufacturing
325320	Pesticide and other agricultural chemical manufacturing
325411	Medicinal and botanical manufacturing
325412	Pharmaceutical preparation manufacturing
325413	In-vitro diagnostic substance manufacturing
325414	Biological product (except diagnostic) manufacturing
325510	Paint and coating manufacturing
325520	Adhesive manufacturing
325610	Soap and cleaning compound manufacturing
325620	Toilet preparation manufacturing
325910	Printing ink manufacturing
3259A0	All other chemical product and preparation manufacturing
326110	Plastics packaging materials and unlaminated film and sheet manufacturing
326120	Plastics pipe, pipe fitting, and unlaminated profile shape manufacturing
326130	Laminated plastics plate, sheet (except packaging), and shape manufacturing
326140	Polystyrene foam product manufacturing
326150	Urethane and other foam product (except polystyrene) manufacturing
326160	Plastics bottle manufacturing
326190	Other plastics product manufacturing
326210	Tire manufacturing
326220	Rubber and plastics hoses and belting manufacturing
326290	Other rubber product manufacturing
327100	Clay product and refractory manufacturing
327200	Glass and glass product manufacturing
327310	Cement manufacturing
327320	Ready-mix concrete manufacturing
327330	Concrete pipe, brick, and block manufacturing
327390	Other concrete product manufacturing
327400	Lime and gypsum product manufacturing
327910	Abrasive product manufacturing
327991	Cut stone and stone product manufacturing
327992	Ground or treated mineral and earth manufacturing
327993	Mineral wool manufacturing

327999	Miscellaneous nonmetallic mineral products
331110	Iron and steel mills and ferroalloy manufacturing
331200	Steel product manufacturing from purchased steel
331313	Alumina refining and primary aluminum production
331314	Secondary smelting and alloying of aluminum
33131B	Aluminum product manufacturing from purchased aluminum
331410	Nonferrous Metal (except Aluminum) Smelting and Refining
331420	Copper rolling, drawing, extruding and alloying
331490	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying
331510	Ferrous metal foundries
331520	Nonferrous metal foundries
332114	Custom roll forming
332119	Metal crown, closure, and other metal stamping (except automotive)
33211A	All other forging, stamping, and sintering
332200	Cutlery and handtool manufacturing
332310	Plate work and fabricated structural product manufacturing
332320	Ornamental and architectural metal products manufacturing
332410	Power boiler and heat exchanger manufacturing
332420	Metal tank (heavy gauge) manufacturing
332430	Metal can, box, and other metal container (light gauge) manufacturing
332500	Hardware manufacturing
332600	Spring and wire product manufacturing
332710	Machine shops
332720	Turned product and screw, nut, and bolt manufacturing
332800	Coating, engraving, heat treating and allied activities
332913	Plumbing fixture fitting and trim manufacturing
33291A	Valve and fittings other than plumbing
332991	Ball and roller bearing manufacturing
332996	Fabricated pipe and pipe fitting manufacturing
332999	Other fabricated metal manufacturing
33299A	Ammunition, arms, ordnance, and accessories manufacturing
333111	Farm machinery and equipment manufacturing
333112	Lawn and garden equipment manufacturing
333120	Construction machinery manufacturing
333130	Mining and oil and gas field machinery manufacturing
333242	Semiconductor machinery manufacturing
33329A	Other industrial machinery manufacturing
333314	Optical instrument and lens manufacturing
333316	Photographic and photocopying equipment manufacturing
333318	Other commercial and service industry machinery manufacturing
333413	Industrial and commercial fan and blower and air purification equipment manufacturing
333414	Heating equipment (except warm air furnaces) manufacturing
333415	Air conditioning, refrigeration, and warm air heating equipment manufacturing
333511	Industrial mold manufacturing
333514	Special tool, die, jig, and fixture manufacturing
333517	Machine tool manufacturing
33351B	Cutting and machine tool accessory, rolling mill, and other metalworking machinery manufacturing
333611	Turbine and turbine generator set units manufacturing
333612	Speed changer, industrial high-speed drive, and gear manufacturing
333613	Mechanical power transmission equipment manufacturing
333618	Other engine equipment manufacturing
333912	Air and gas compressor manufacturing
33391A	Pump and pumping equipment manufacturing
333920	Material handling equipment manufacturing
333991	Power-driven handtool manufacturing
333993	Packaging machinery manufacturing
333994	Industrial process furnace and oven manufacturing
33399A	Other general purpose machinery manufacturing
33399B	Fluid power process machinery
334111	Electronic computer manufacturing
334112	Computer storage device manufacturing
334118	Computer terminals and other computer peripheral equipment manufacturing
334210	Telephone apparatus manufacturing
334220	Broadcast and wireless communications equipment
334290	Other communications equipment manufacturing
334300	Audio and video equipment manufacturing
334413	Semiconductor and related device manufacturing
334418	Printed circuit assembly (electronic assembly) manufacturing
33441A	Other electronic component manufacturing
334510	Electromedical and electrotherapeutic apparatus manufacturing

334511	Search, detection, and navigation instruments manufacturing
334512	Automatic environmental control manufacturing
334513	Industrial process variable instruments manufacturing
334514	Totalizing fluid meter and counting device manufacturing
334515	Electricity and signal testing instruments manufacturing
334516	Analytical laboratory instrument manufacturing
334517	Irradiation apparatus manufacturing
33451A	Watch, clock, and other measuring and controlling device manufacturing
334610	Manufacturing and reproducing magnetic and optical media
335110	Electric lamp bulb and part manufacturing
335120	Lighting fixture manufacturing
335210	Small electrical appliance manufacturing
335221	Household cooking appliance manufacturing
335222	Household refrigerator and home freezer manufacturing
335224	Household laundry equipment manufacturing
335228	Other major household appliance manufacturing
335311	Power, distribution, and specialty transformer manufacturing
335312	Motor and generator manufacturing
335313	Switchgear and switchboard apparatus manufacturing
335314	Relay and industrial control manufacturing
335911	Storage battery manufacturing
335912	Primary battery manufacturing
335920	Communication and energy wire and cable manufacturing
335930	Wiring device manufacturing
335991	Carbon and graphite product manufacturing
335999	All other miscellaneous electrical equipment and component manufacturing
336111	Automobile manufacturing
336112	Light truck and utility vehicle manufacturing
336120	Heavy duty truck manufacturing
336211	Motor vehicle body manufacturing
336212	Truck trailer manufacturing
336213	Motor home manufacturing
336214	Travel trailer and camper manufacturing
336310	Motor vehicle gasoline engine and engine parts manufacturing
336320	Motor vehicle electrical and electronic equipment manufacturing
336350	Motor vehicle transmission and power train parts manufacturing
336360	Motor vehicle seating and interior trim manufacturing
336370	Motor vehicle metal stamping
336390	Other Motor Vehicle Parts Manufacturing
3363A0	Motor vehicle steering, suspension component (except spring), and brake systems manufacturing
336411	Aircraft manufacturing
336412	Aircraft engine and engine parts manufacturing
336413	Other aircraft parts and auxiliary equipment manufacturing
336414	Guided missile and space vehicle manufacturing
33641A	Propulsion units and parts for space vehicles and guided missiles
336500	Railroad rolling stock manufacturing
336611	Ship building and repairing
336612	Boat building
336991	Motorcycle, bicycle, and parts manufacturing
336992	Military armored vehicle, tank, and tank component manufacturing
336999	All other transportation equipment manufacturing
337110	Wood kitchen cabinet and countertop manufacturing
337121	Upholstered household furniture manufacturing
337122	Nonupholstered wood household furniture manufacturing
337127	Institutional furniture manufacturing
33712N	Other household nonupholstered furniture
337215	Showcase, partition, shelving, and locker manufacturing
33721A	Office furniture and custom architectural woodwork and millwork manufacturing
337900	Other furniture related product manufacturing
339112	Surgical and medical instrument manufacturing
339113	Surgical appliance and supplies manufacturing
339114	Dental equipment and supplies manufacturing
339115	Ophthalmic goods manufacturing
339116	Dental laboratories
339910	Jewelry and silverware manufacturing
339920	Sporting and athletic goods manufacturing
339930	Doll, toy, and game manufacturing
339940	Office supplies (except paper) manufacturing
339950	Sign manufacturing
339990	All other miscellaneous manufacturing

4200ID	Customs duties
423100	Motor vehicle and motor vehicle parts and supplies
423400	Professional and commercial equipment and supplies
423600	Household appliances and electrical and electronic goods
423800	Machinery, equipment, and supplies
423A00	Other durable goods merchant wholesalers
424200	Drugs and druggists sundries
424400	Grocery and related product wholesalers
424700	Petroleum and petroleum products
424A00	Other nondurable goods merchant wholesalers
425000	Wholesale electronic markets and agents and brokers
441000	Motor vehicle and parts dealers
444000	Building material and garden equipment and supplies dealers
445000	Food and beverage stores
446000	Health and personal care stores
447000	Gasoline stations
448000	Clothing and clothing accessories stores
452000	General merchandise stores
454000	Nonstore retailers
481000	Air transportation
482000	Rail transportation
483000	Water transportation
484000	Truck transportation
485000	Transit and ground passenger transportation
486000	Pipeline transportation
48A000	Scenic and sightseeing transportation and support activities for transportation
491000	Postal service
492000	Couriers and messengers
493000	Warehousing and storage
4B0000	All other retail
511110	Newspaper publishers
511120	Periodical Publishers
511130	Book publishers
5111A0	Directory, mailing list, and other publishers
511200	Software publishers
512100	Motion picture and video industries
512200	Sound recording industries
515100	Radio and television broadcasting
515200	Cable and other subscription programming
517110	Wired telecommunications carriers
517210	Wireless telecommunications carriers (except satellite)
517A00	Satellite, telecommunications resellers, and all other telecommunications
518200	Data processing, hosting, and related services
519130	Internet publishing and broadcasting and Web search portals
5191A0	News syndicates, libraries, archives and all other information services
522A00	Nondepository credit intermediation and related activities
523900	Other financial investment activities
523A00	Securities and commodity contracts intermediation and brokerage
524113	Direct life insurance carriers
5241XX	Insurance carriers, except direct life
524200	Insurance agencies, brokerages, and related activities
525000	Funds, trusts, and other financial vehicles
52A000	Monetary authorities and depository credit intermediation
531HSO	Owner-occupied housing
531HST	Tenant-occupied housing
531ORE	Other real estate
532100	Automotive equipment rental and leasing
532400	Commercial and industrial machinery and equipment rental and leasing
532A00	General and consumer goods rental
533000	Lessors of nonfinancial intangible assets
541100	Legal services
541200	Accounting, tax preparation, bookkeeping, and payroll services
541300	Architectural, engineering, and related services
541400	Specialized design services
541511	Custom computer programming services
541512	Computer systems design services
54151A	Other computer related services, including facilities management
541610	Management consulting services
5416A0	Environmental and other technical consulting services
541700	Scientific research and development services

541800	Advertising, public relations, and related services
541920	Photographic services
541940	Veterinary services
5419A0	All other miscellaneous professional, scientific, and technical services
550000	Management of companies and enterprises
561100	Office administrative services
561200	Facilities support services
561300	Employment services
561400	Business support services
561500	Travel arrangement and reservation services
561600	Investigation and security services
561700	Services to buildings and dwellings
561900	Other support services
562000	Waste management and remediation services
611100	Elementary and secondary schools
611A00	Junior colleges, colleges, universities, and professional schools
611B00	Other educational services
621100	Offices of physicians
621200	Offices of dentists
621300	Offices of other health practitioners
621400	Outpatient care centers
621500	Medical and diagnostic laboratories
621600	Home health care services
621900	Other ambulatory health care services
622000	Hospitals
623A00	Nursing and community care facilities
623B00	Residential mental health, substance abuse, and other residential care facilities
624100	Individual and family services
624400	Child day care services
624A00	Community food, housing, and other relief services, including rehabilitation services
711100	Performing arts companies
711200	Spectator sports
711500	Independent artists, writers, and performers
711A00	Promoters of performing arts and sports and agents for public figures
712000	Museums, historical sites, zoos, and parks
713100	Amusement parks and arcades
713200	Gambling industries (except casino hotels)
713900	Other amusement and recreation industries
721000	Accommodation
722110	Full-service restaurants
722211	Limited-service restaurants
722A00	All other food and drinking places
811100	Automotive repair and maintenance
811200	Electronic and precision equipment repair and maintenance
811300	Commercial and industrial machinery and equipment repair and maintenance
811400	Personal and household goods repair and maintenance
812100	Personal care services
812200	Death care services
812300	Dry-cleaning and laundry services
812900	Other personal services
813100	Religious organizations
813A00	Grantmaking, giving, and social advocacy organizations
813B00	Civic, social, professional, and similar organizations
814000	Private households

Appendix E: U-M Purchasing Services Data Fields and Definitions

Provided below are all data fields used by U-M PS for individual purchases:

Data Field Title	Data Field Description
SUPPLIER_PARENT	A description of a grouping of M-Pathways suppliers and/or merchants.
VENDOR_ID	A system assigned number used to uniquely identify a vendor.
VOUCHER_ID	A system assigned number used to uniquely identify a voucher.
VOUCHER_LINE_NUM	A sequential number used to uniquely identify each line of a voucher. In rare instances in VCHR_ACCTG_LINE table the data for this field is derived.
DISTRIB_LINE_NUM	A system assigned, sequential number used to define the accounting distributions for the voucher line or purchase order line.
ITM_ID_VNDR	A code that identifies the item number of the vendor.
ITM_DESCR254	A description of the commodity listed on a specific purchase order line item.
VOUCHER_LINE_DESCR	A textual description of the commodity listed on a specific voucher line item.
VCHR_ACCTG_LINE_QTY	A number representing the unit count of items associated with a voucher.
UNIT_OF_MEASURE	A code representing the unit of measurement to dispense a specific commodity.
UNIT_PRICE	The dollar amount charged by a vendor for a specific line item unit of measurement.
MONETARY_AMOUNT	A number representing the dollar amount associated with a specific set of chartfields for a transaction.
MERCHANDISE_AMT	The voucher line item or purchase order line item dollar amounts.
FREIGHT_AMT	The freight dollar amount billed by a vendor on an invoice.
OTHER_AMOUNT	Other various amounts applied to an invoice.
DEPTID	A code that identifies each academic or administrative unit that has programmatic, operational and fiscal (including budgetary) responsibility.
DEPT_DESCR	A textual description of the code that identifies each academic or administrative unit that has programmatic, operational and fiscal (including budgetary) responsibility.
DEPT_GRP_DESCR	A textual description of the code used to group U of M departments for reporting purposes. This description is used to group U of M schools, colleges, administrative areas, and vice presidential areas.
DEPT_GRP_VP_AREA_DESCR	A textual description of the code used to group U of M department groups by President, Vice President, or Chancellor, based on direct reporting lines.
FISCAL_YEAR	The U of M fiscal year in the format CCYY. The U of M fiscal year runs from July through June.
ACCOUNTING_PERIOD	A code used to identify the university accounting period which represents a fiscal calendar month or an adjustment period.
PO_ID	A system assigned number used to uniquely identify a specific order.
VOUCHER_TYPE_DESCRSHORT	An abbreviated textual description identifying the type or style of voucher. Examples of valid values:P-Card; Non PO; PO; SUB; Reversal
VOUCHER_ORIGIN	A code representing the origin associated with the person/process that created the voucher. Examples of valid values:EDI = EDI; HIN = Hosp Inv; ONL = Online; PS = Purch Svcs
VCHR_SRC_DES	A textual description of the originating process or activity which created the voucher. Examples of valid values:Online; EDI; Custom Interfaces; Marketsite; XML Invoices

Appendix F: Example UNSPSC Code Hierarchy

Provided below is an example of the UNSPSC Code Hierarchy – a series of 2 digit identifiers of increasing detail.

Hierarchy:	Code:	Category Number:	Description:
Segment	70000000	70	Farming and Fishing and Forestry and Wildlife Contracting Services
Family	70140000	14	Crop production and management and protection
Class	70141900	19	Crop production
Commodity	70141902	02	Fruit or tree nuts harvesting services

Appendix G: Example Account Group Disaggregation

Below is an example disaggregation of the U-M spending account group ‘Laboratory Research Supplies’ into its accounts:

Account Group:	Laboratory Research Supplies	\$1,286,027,954
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...breaks down into:

Account Descriptions:	Spending (\$):
Pharmaceuticals	905,103,874
Surgical/Medical Supplies	204,161,392
Laboratory Supplies - General	109,878,312
Animal Care Per Diem ULAM ONLY	18,029,745
Chemicals & Related Products	15,704,382
Radioactive Chemicals	10,265,425
Gases	4,329,543
ULAM Managed Vet Svc Fee	4,057,840
Animal Purchases ULAM ONLY	3,653,468
Laboratory Animals	3,552,032
Optical Supplies	2,051,177
Animal Care Services ULAM ONLY	1,779,669
Electronic Supplies	1,719,684
Optical Supplies-Contact Lens	815,246
Dental Supplies	739,528
Laboratory Animal Care	122,642
Teeth	56,749
X-Ray Film	7,247
340B Savings*	(253,183,193)

*Account excluded from analysis

Appendix H: Inclusion/Exclusion of Accounts from Analysis

Table G1 contains the total sum of market-based spending analyzed in this study when compared to the FY 2020 FY line item reported by the University of Michigan. The cause for this increase in total spend can be attributed to the removal of savings or recharge accounts.

This is followed by Table G2, a breakdown of all accounts that were included/excluded from this analysis.

Table H1: Overview of Total Spend Analyzed

Total Spend Analyzed (2020 USD):	\$2,809,241,627.20
Total Spend Reported by University (2020 USD):	\$2,574,614,000.00
% Increase	9%

Table H2: Breakdown of Included/Excluded Accounts and Corresponding Information

Account Group	Account:	Spend (thous. \$)	% of AG Total	Confidence Rating	IAT Overlap	Inclusion	Exclusion
Communications	Telecom Svc (Not Includg Umtel)	10,755	34.6%	A		X	
	Voice Services ITCOM	7,474	24.1%	B		X	
	Data Network ITCOM	3,813	12.3%	B		X	
	Service Requests ITCOM	2,958	9.5%	B		X	
	Cellular Phone	2,548	8.2%	A		X	
	Video Services ITCOM	1,307	4.2%	B		X	
	Pagers	1,092	3.5%	A		X	
	Telephones & Accessories	359	1.2%	B		X	
	Remote Locat ITCOM	144	0.5%	B		X	
	Centrex Equip,Line,Featur e Rtl	132	0.4%	B		X	
	Long Distance Calls ITCOM	127	0.4%	B		X	
	Telephone Admin Fees	95	0.3%	A		X	

	Telephone Network Fees	85	0.3%	A		X	
	Local Charges ITCom	59	0.2%	B		X	
	Local Phone Calls	37	0.1%	B		X	
	Long Distance	28	0.1%	B		X	
	Telephone Service/Repair	16	0.1%	A		X	
	Facsimile	7	0.0%	A		X	
	Affiliate Data Circuit	3	0.0%	B		X	
	Equip,Line,Feature Rntl ITCom	0	0.0%	B		X	
Computing Services and Supplies	Computer & Peripheral Mtnce	53,638	36.5%	A		X	
	Computer Software/Licenses	35,446	24.1%	A		X	
	Computer Supplies	19,666	13.4%	B		X	
	Business Software Maintenance	11,376	7.7%	A		X	
	Computing Services	10,731	7.3%	B		X	
	Backbone Charge	7,851	5.3%	A			X
	Internet Charge	2,468	1.7%	A		X	
	Database Purchase & Rental	1,595	1.1%	B		X	
	Data Management Services	1,055	0.7%	B		X	
	Rack & Server Utilization Expe	954	0.6%	B		X	
	Computer Programming	888	0.6%	A		X	
	Computing Storage	651	0.4%	B		X	
	Data Processing	472	0.3%	B		X	
	Micro Consulting Services	118	0.1%	B		X	
	Computing Signon	8	0.0%	B		X	
	Computing Processing	5	0.0%	B		X	

	Computing Operations	5	0.0%	B		X	
	Demo Software Production Cost	2	0.0%	A		X	
	CATI/CAPI Programming Service	0	0.0%	A		X	
General Expenses	Serv Of Others(Non-Consultant)	260,889	28.6%	C		X	
	Sub(K) - Portion Over \$25K	104,943	11.5%	D			X
	Bad Debts	67,516	7.4%	E			X
	P-Card Clearing Account	60,347	6.6%	C			X
	Misc Supplies and Other	49,344	5.4%	C		X	
	Laundry	38,519	4.2%	A		X	
	Cost of Goods Sold	22,688	2.5%	C		X	
	Serv Unit Materials Recharged	22,172	2.4%	C		X	
	Rental Expense	14,824	1.6%	B		X	
	Sub-Award - Portion Over \$25K	14,820	1.6%	D			X
	Memberships & Dues	13,372	1.5%	B		X	
	Computers - Under \$5,000	13,294	1.5%	A		X	
	Sub(K) - Portion Under \$25K	11,061	1.2%	D			X
	Contractual Srvcs-Nursing	10,773	1.2%	A		X	
	Food	9,435	1.0%	B	X		X
	Furniture	9,247	1.0%	B		X	
	Non-Capital Equipment	9,010	1.0%	C		X	
	Office Supplies	8,326	0.9%	B		X	
	Postage/Mailing	7,632	0.8%	B		X	
	Marketing Material	7,494	0.8%	C		X	
	Printing - Outside	7,264	0.8%	B		X	
	Advertising	6,227	0.7%	B		X	
Licenses (Non-Software)	6,074	0.7%	A		X		

Payments to Agency Fund	5,859	0.6%	C		X	
Conferences	5,622	0.6%	B		X	
Parking Expense	5,113	0.6%	A		X	
Pub/Subscription/Print Matter	5,111	0.6%	B		X	
Custodial Supplies	5,067	0.6%	B		X	
Single Use Access Databases	4,785	0.5%	A		X	
Contract Srvs Nur Pat Sit	4,712	0.5%	A		X	
Security	4,633	0.5%	B		X	
Freight Charges	4,457	0.5%	B		X	
Meat	4,424	0.5%	B	X		X
Photographic/Electronic Media	4,281	0.5%	B		X	
Guarantee Payments	3,817	0.4%	D		X	
Training Table Expense	3,646	0.4%	A		X	
Operational Equipment Leases	3,563	0.4%	B		X	
Respondent Costs	3,537	0.4%	D		X	
Mach Rentl (Except Copy Equip)	3,196	0.4%	B		X	
Electrical Supplies	3,124	0.3%	B		X	
Sports Equipment - Adidas	2,986	0.3%	B		X	
Beverages	2,938	0.3%	B	X		X
Equipment Use Charge-Interfund	2,681	0.3%	D		X	
Participant - M	2,622	0.3%	D		X	
Produce	2,601	0.3%	B	X		X
Managed Copier Program	2,597	0.3%	B		X	
Supplies-Instruct Materials	2,595	0.3%	C		X	
Research Publication Costs	2,564	0.3%	B		X	
Sub-Award - Portion Under \$25K	2,545	0.3%	D			X
Surveys	2,438	0.3%	B		X	

Employee Development	2,415	0.3%	B		X	
Property Tax	2,354	0.3%	D			X
Special Event	2,337	0.3%	C		X	
Dairy	2,290	0.3%	B	X		X
Sports Equipment	2,246	0.2%	B		X	
Food & Beverages	2,083	0.2%	B	X		X
Web Design & Development	1,874	0.2%	B		X	
Prize Gifts & Svc Awds-NonEmps	1,826	0.2%	C		X	
Frozen Food	1,794	0.2%	B	X		X
Linen	1,744	0.2%	A		X	
Participant - L	1,635	0.2%	D			X
Merchandise Purchases	1,597	0.2%	C		X	
Printing & Reproduction	1,577	0.2%	B		X	
Recruitment - Other	1,523	0.2%	C		X	
Com Dent Labs/Implant Supplies	1,464	0.2%	B		X	
Other Home Game Expenses	1,423	0.2%	C		X	
Wearing Apparel	1,393	0.2%	B		X	
Sponsored Owned Equipment	1,379	0.2%	C		X	
Transcription Services	1,374	0.2%	A		X	
Recruitment - Advertising	1,315	0.1%	B		X	
Paper Products	1,279	0.1%	B		X	
Capital Leases	1,171	0.1%	B		X	
Transportation (Non Travel)	1,149	0.1%	B		X	
Equipment/Partial Replacements	1,049	0.1%	C		X	
Contracted Labor	1,031	0.1%	C		X	
Smallwares	979	0.1%	B		X	
Officials Fees	904	0.1%	A		X	
Outsourcing	895	0.1%	C		X	
Use Tax	841	0.1%	D			X
Inventory Adjustment	839	0.1%	D		X	

Public Relations	763	0.1%	B		X	
Printing	719	0.1%	A		X	
Photographs	651	0.1%	A		X	
Sales Tax Expense	647	0.1%	D		X	X
Copy Center Service	600	0.1%	A		X	
Patient Clinical Medical Equip	546	0.1%	B		X	
Artwork	542	0.1%	B		X	
Productions	539	0.1%	B		X	
Collection Agcy_Lit Exp_Offset	519	0.1%	B		X	
Graphic Design Services	518	0.1%	A		X	
Photo Cop, Fax Mach & Printers	497	0.1%	A		X	
Publication Design & Dev	486	0.1%	B		X	
Training Services	485	0.1%	B		X	
Bakery	477	0.1%	B	X		X
Refreshments	474	0.1%	B	X		X
Direct Mail Costs	465	0.1%	B		X	
Vacation Board	433	0.0%	B		X	
Other Post Season Expenses	433	0.0%	C		X	
Production Expense	432	0.0%	B		X	
Tickets	393	0.0%	A		X	
Obsolescence Expense	391	0.0%	E		X	
Field Hiring & Training	372	0.0%	B		X	
Flowers & Decorations	368	0.0%	B		X	
Appliances (less than \$5,000)	359	0.0%	B		X	
Participant - O	344	0.0%	D			X
Sports Supplies	339	0.0%	B		X	
Pre-Press Costs	323	0.0%	B		X	
Health Physics Supplies	266	0.0%	A		X	
Amortization Expense	247	0.0%	E		X	
Facility Supplies	231	0.0%	C		X	
Shop Supplies	218	0.0%	C		X	

Clothing and Apparel	216	0.0%	B		X	
Third Party Owned Equipment	197	0.0%	C		X	
Precious Metals (Gold, Etc.)	190	0.0%	A		X	
Non-Capital Musical Instrument	184	0.0%	A		X	
Insurance Premium Tax	163	0.0%	D			X
Publicity Expense	160	0.0%	B		X	
China, glass and flatware	160	0.0%	A		X	
Recognition Mementos	149	0.0%	C		X	
Freight on Purchases	132	0.0%	B		X	
Exhibit Expense	123	0.0%	B		X	
U-Attic Pallet Storage	105	0.0%	B		X	
Entertainers & Bands	91	0.0%	A		X	
Setup	76	0.0%	C		X	
Publishing Subsidies	67	0.0%	B		X	
Mgmt Fee-General Expense	64	0.0%	A		X	
Copywriting	61	0.0%	A		X	
International Marketing Exp	60	0.0%	A		X	
Premium Supplies	51	0.0%	C		X	
CATI Hardware Recovery	48	0.0%	B		X	
Recordings	46	0.0%	B		X	
Movies	37	0.0%	B		X	
Social Events	29	0.0%	C		X	
Stores Rental Pool	24	0.0%	B			X
Customer S&H Charges-Int'l	22	0.0%	B		X	
Stationery Item	22	0.0%	B		X	
Mattresses	21	0.0%	A		X	
Participant - T	19	0.0%	D			X

Engraving/Etching	12	0.0%	A		X	
Interlibrary Loans of Books	7	0.0%	B		X	
Photocopy Equip Rental	7	0.0%	A		X	
Museum Artifacts	5	0.0%	B		X	
Audio Data Storage Supplies	5	0.0%	B		X	
Petty Cash	5	0.0%	C		X	
Complimentary Copies & Related	5	0.0%	B		X	
Seasonal Catalog/Trade Ad Exp	5	0.0%	B		X	
Federal Income Tax Expense	2	0.0%	D		X	
Food Staples	2	0.0%	B	X		X
Facility Security	2	0.0%	A		X	
Firearms	2	0.0%	A		X	
Advertising - Digital	1	0.0%	A		X	
Government Relations	0	0.0%	B		X	
Compostable Products	0	0.0%	C		X	
Eggs/Butter/Cheese	0	0.0%	A	X		X
Officers (Lodging, meals,...)	0	0.0%	B	X		X
Shared Srvc Clearing Account	0	0.0%	D			X
Per Capita Overhead	0	0.0%	E			X
Unrelated Business Income Tax	0	0.0%	D			X
Employee Relations	0	0.0%	C			X
Agency Donations	0	0.0%	C			X
Capital Asset Acquisitions	0	0.0%	D			X
Housing Distribution	0	0.0%	D			X
Investmnt Adj To Tax Lot Basis	0	0.0%	D			X

	Manual Close Write-Off	0	0.0%	D			X
	Ammunition	-2	0.0%	A			X
	Mgmt Fee-Salaries & Benefits	-2	0.0%	B			X
	EDI Fees	-3	0.0%	C			X
	Participant - R	-5	0.0%	D			X
	Gift & Grant in Kind-Non Cap	-10	0.0%	C			X
	Cash Over and Short	-20	0.0%	E			X
	Gen Fnd/Studnt Fee Allocation	-30	0.0%	E			X
	Damages (Damage Deposits)	-51	0.0%	E			X
	Pre-Press Contra	-174	0.0%	B			X
	Spon Owned Equip - Component	-218	0.0%	C			X
	Bakery Non-Store	-256	0.0%	B			X
	Equip Fabrication-Spon Only	-368	0.0%	C			X
	Lump Sum Advance	-529	-0.1%	E			X
	Non-Transact Rebates/Discounts	-872	-0.1%	E			X
	Administrative Reallocation	-9,864	-1.1%	E			X
	Recharged Overhead	-15,082	-1.7%	E			X
Fees and Services	DPSS Recharge Exps.	20,649	18.9%	D			X
	Interunit Payments	20,514	18.8%	D			X
	Consulting	19,117	17.5%	C		X	
	Legal Expenses	14,425	13.2%	B		X	
	Credit Card Service Fees	6,460	5.9%	B		X	
	Human Subject Incentives	5,614	5.1%	D		X	
	Program Fees	4,724	4.3%	C		X	
	Courier Services	3,594	3.3%	B		X	
	Lurie Facility Expense	1,850	1.7%	C		X	
Bank Fees-Lockbox Services	1,589	1.5%	B		X		

ISR Services	1,369	1.3%	C		X	
Facility Use Fees	1,338	1.2%	B		X	
Analysis Fees	1,226	1.1%	C		X	
Research & Development	1,017	0.9%	B		X	
Photo / Electronic Media Svcs	698	0.6%	B		X	
Royalty Expense	695	0.6%	A		X	
Recharged Operating Expenses	532	0.5%	D			X
Payment for Student Fees	461	0.4%	D		X	
Athletic Fees	451	0.4%	C		X	
OSEH Services	391	0.4%	B		X	
Recharge Fac/Utility Expenses	354	0.3%	D		X	
Office Services	264	0.2%	B		X	
Bank Fees-ACH Services	258	0.2%	B		X	
Bank Fees-Other Charges	250	0.2%	B		X	
Bank Fees-Reporting Services	190	0.2%	B		X	
Evaluation & Exam Service	188	0.2%	B		X	
Duplicating	178	0.2%	B		X	
Pest Control	149	0.1%	A		X	
Histology Service Fees	146	0.1%	B		X	
MicroCT Core Services Fees	124	0.1%	B		X	
Audit Services	123	0.1%	A		X	
Satellite Distribution	118	0.1%	B		X	
Bank Fees-Disbursement Svcs	118	0.1%	B		X	
Bank Fees-Depository Services	117	0.1%	B		X	
MCard Fees	104	0.1%	C		X	
LPD Course Fees	73	0.1%	B		X	
Wire/Draft Services	59	0.1%	B		X	
Subject Fees	46	0.0%	D		X	
Bank Fees-Reconciliation Svcs	41	0.0%	B		X	
Fees for Distributed Titles	40	0.0%	B		X	

	Bank Fees- General Account Svcs	21	0.0%	B		X	
	Microarray Core Service Fees	18	0.0%	B		X	
	Document & Imaging Fees	14	0.0%	B		X	
	Engineering Consulting	8	0.0%	A		X	
	ISDN/Studio Rental	7	0.0%	B		X	
	Award Entry Fee	5	0.0%	C		X	
	Other Human Subject Expenses	1	0.0%	D		X	
	Certification Fees	0	0.0%	B		X	
	Bank Fees - Wire/Draft Fees	-5	0.0%	B			X
	Misc Author/Editor Fees	-5	0.0%	C			X
	Bank Fees- Earnings Credit	-21	0.0%	B			X
	Recharge Administrative Exp	-341	-0.3%	D			X
	Insur. Loss - Curr Yr Incurred	100,005	43.8%	B			X
	Insurance Premium Expense	60,338	26.4%	B		X	
	Malpractice Insurance	39,353	17.2%	B		X	
	General Insurance	20,592	9.0%	B		X	
	Liability Claim Expense	8,341	3.7%	B		X	
	Non-Occ Claim Expense	256	0.1%	B		X	
	Medical Case Mngment Expenses	1	0.0%	B		X	
	Hlth Exp- Reinsurance	0	0.0%	B			X
	Worker's Comp Claim Exp.	0	0.0%	B			X
	Claim Recovery - Captive	-36	0.0%	B			X
	Claim Recovery - Commercial	-60	0.0%	B			X
	Insurance Claim Recovery	-281	-0.1%	B			X
Int ern al Re bill	Rebill Food Expense	111	-0.1%	D			X

	Rebill Custodial Expense	2	0.0%	D			X
	Rebill Supply Expense	1	0.0%	D			X
	Rebill Dept Commit for Svcs	0	0.0%	D			X
	Contract Nursing Rebill	0	0.0%	D			X
	Nursing MNA Reg Rebill	0	0.0%	D			X
	ACS Margin Improv Sharing Rebl	0	0.0%	D			X
	Rebill Srvc - Patient Billing	0	0.0%	D			X
	Chairman's Tax	0	0.0%	D			X
	Strategic Investment Allocatio	0	0.0%	D			X
	Rebill Security Expense	-5	0.0%	D			X
	Rebill Campus Laundry	-12	0.0%	D			X
	Rebill Rent Expense	-62	0.0%	D			X
	Rebill SOD Overhead	-77	0.1%	D			X
	Rebill Dental Stores	-248	0.2%	D			X
	Rebill Postage Exp	-315	0.2%	D			X
	Rebill Support for Services	-866	0.6%	D			X
	Rebill Pharm Supp Exp	-1,167	0.9%	D			X
	Rebill Medical Supply Exp	-1,750	1.3%	D			X
	Rebill Fac & Ops Expense	-6,638	4.9%	D			X
	Rebill Hospital Laundry	-37,373	27.8%	D			X
	Rebill Credit	-86,146	64.0%	D			X
Laboratory Research Supplies	Pharmaceuticals	905,104	87.6%	B		X	
	Surgical/Medical Supplies	204,161	19.8%	B		X	
	Laboratory Supplies - General	109,878	10.6%	B		X	

	Animal Care Per Diem ULAM ONLY	18,030	1.7%	B		X	
	Chemicals & Related Products	15,704	1.5%	B		X	
	Radioactive Chemicals	10,265	1.0%	B		X	
	Gases	4,330	0.4%	B		X	
	ULAM Managed Vet Svc Fee	4,058	0.4%	B		X	
	Animal Purchases ULAM ONLY	3,653	0.4%	B		X	
	Laboratory Animals	3,552	0.3%	B		X	
	Optical Supplies	2,051	0.2%	B		X	
	Animal Care Services ULAM ONLY	1,780	0.2%	B		X	
	Electronic Supplies	1,720	0.2%	B		X	
	Optical Supplies-Contact Lens	815	0.1%	B		X	
	Dental Supplies	740	0.1%	B		X	
	Laboratory Animal Care	123	0.0%	B		X	
	Teeth	57	0.0%	A		X	
	X-Ray Film	7	0.0%	A		X	
	340B Savings	-253,183	- 24.5%	D			X
Medical	Shared Srvc Clearing Bud Cat	0	0.0%	D			X
	Technical Services	0	0.0%	D			X
	Cancer Center WRVU	0	0.0%	D			X
	Anesthesiology Trsf	0	0.0%	D			X
	PhD Salaries	0	0.0%	D			X
	Grad Med Ed Pmts to Med Sch	0	0.0%	D			X
	InternMedHospitalist	0	0.0%	D			X
	Professional Charges - Alloc	0	0.0%	D			X
	Path Tech Services	0	0.0%	D			X
	PhD Services	0	0.0%	D			X

	Patient Care Revenue WRVU	0	0.0%	D			X
	Med Ctr Hosp/FGP Controllable	0	0.0%	D			X
	Clinic Expenses Reimb-Payroll	0	0.0%	D			X
	UMMG RVU Dept Admin Pymnt In	0	0.0%	D			X
	UMMG RVU Dept Incentives In	0	0.0%	D			X
	Professional Allow - Direct	0	0.0%	D			X
	Professional Allow - Alloc	0	0.0%	D			X
	Professional Charges - Direct	0	0.0%	D			X
	Clinic Expenses Reim-Commodity	0	0.0%	D			X
	Admin Services	0	0.0%	D			X
	PrimCareSalaries	0	0.0%	D			X
	Radiology - WRVU	0	0.0%	D			X
	Faculty RVU Payments	0	0.0%	D			X
	Other Administrative Service	-129	100.0%	D			X
Space Rental and Renovations	Space Rental-Non Capital Lease	54,535	89.4%	B		X	
	Space Rental - Non Lease	5,492	9.0%	B		X	
	Remodeling & Design	598	1.0%	B		X	
	Fulfillment	380	0.6%	B		X	
Student Loans	Student Loan-Clearing	-1	100.0%	C			X
Transfers and Distributions	Prior Period Adjustments	0	0.0%	E			X
	Trf To Cover Overdraft	-17	100.0%	D			X
Use Charge Service Facilities	ITS Use Charge	14,597	93.2%	D			X
	Use Chg Lab Animal Med - QAF	869	5.5%	D			X

	Use Charge - Equipment	199	1.3%	D			X
	IRB Review Service Fee	0	0.0%	D			X
Medical Expenses	Medical Surgical Implants	23,801	14.9%	B		X	
	Implants, Cardiothoracic	21,813	13.7%	B		X	
	Cadaver	13,246	8.3%	B		X	
	Implants, Orthopedic	12,149	7.6%	B		X	
	Implants, Electrophysiology	11,731	7.3%	B		X	
	Implants Neurological	9,074	5.7%	B		X	
	Implants, Vascular	8,811	5.5%	B		X	
	Implants, Spine	8,804	5.5%	B		X	
	Med Sutures/Wound Clos Supply	7,157	4.5%	B		X	
	I.V. Sets and Tubing	5,861	3.7%	B		X	
	Implants, GI/GU	5,454	3.4%	B		X	
	Clinical Expense	4,846	3.0%	B		X	
	Implants, Biological/Tissues	4,705	2.9%	B		X	
	Med Instruments & Surg Supplies	4,324	2.7%	B		X	
	I.V. Solution/Sets	4,142	2.6%	B		X	
	Implants, Opthymology	2,809	1.8%	B		X	
	Research Patient Care	2,720	1.7%	B		X	
	Implants, Intervt. Cardiology	2,078	1.3%	B		X	
	Implants, Otolaryngology	1,563	1.0%	B		X	
	Clinical Programs	1,161	0.7%	C		X	
	Health Expense-Inpatient FFS	1,093	0.7%	B		X	
	Provider Incentive Expense	466	0.3%	C		X	
Clinical Research Pro Fees	440	0.3%	B		X		

Implants, Plastics	430	0.3%	B		X	
Implants, Oral	391	0.2%	B		X	
Medical Surveillance Services	251	0.2%	B		X	
Admin Services	129	0.1%	B		X	
Hlth Exp- Prescription	118	0.1%	B		X	
Implants, General	81	0.1%	B		X	
Technical - Consulting Svcs	0	0.0%	D			X
Clinic Expenses Reimb	0	0.0%	D			X
Clinical Direct Allocations	0	0.0%	D			X
Med Ctr Controllable Overhead	0	0.0%	D			X
RVU Payment - Alloc	0	0.0%	D			X
Ph D Faculty Expense	0	0.0%	C			X
PathTechSvcs	0	0.0%	C			X
Clinical Indirect Allocations	0	0.0%	D			X
UMMG RVU Dept Incentives Out	0	0.0%	D			X
Primary Care Expense	0	0.0%	D			X
GME Payment (Grad. Med. Educ.)	0	0.0%	D			X
Radiology - WRVU	0	0.0%	D			X
RVU Payment - Direct	0	0.0%	D			X
Overhead Transfer - Radiology	0	0.0%	D			X
UMMG RVU Dept Admin Pymnt Out	0	0.0%	D			X
Patient Care Revenue WRVU	0	0.0%	D			X
Int Med Hosp	0	0.0%	D			X
Administrative faculty expense	0	0.0%	D			X

	Ph.D Svcs	0	0.0%	D			X
	Cancer Center WRVU	0	0.0%	D			X
	Payment for Central Support	0	0.0%	D			X
	Institutional Overhead Expense	-26	0.0%	D			X
Travel, Hosting, and Transportation	Hosting	25,120	19.7%	B		X	
	Domestic Travel Lodging	19,871	15.6%	B		X	
	Domestic Travel Airfare	18,654	14.7%	A	X		X
	Domestic Travel-Ground Transp	9,184	7.2%	B		X	
	U Transp Bus Operations	8,719	6.9%	A	X		X
	Domestic Travel - Other	8,126	6.4%	C	X		X
	Foreign Travel Airfare	7,736	6.1%	A	X		X
	Domestic Travel Meals	5,433	4.3%	B		X	
	U Transp Maint & Repairs	3,534	2.8%	B		X	
	U Transp Yearly Lease	3,443	2.7%	B		X	
	Foreign Travel Lodging	3,316	2.6%	B		X	
	Foreign Travel Meals	2,363	1.9%	B		X	
	U Transp Svcs Fuel	1,452	1.1%	B	X		X
	Foreign Travel - Other	1,415	1.1%	C	X		X
	Recruiting - Off Campus	1,357	1.1%	B		X	
	U Transp Fuel Deliveries	1,282	1.0%	B	X		X
	Post Season Hotel/Meals	1,170	0.9%	B		X	
	Registration Fees	1,134	0.9%	C		X	
	Recruiting - On Campus	984	0.8%	B		X	
	Post Season Air Transportation	839	0.7%	A	X		X
Foreign Travel-Ground Transp	799	0.6%	B	X		X	

	Profess. Development-Travel	596	0.5%	B	X		X
	U Transp Daily Rental	275	0.2%	B		X	
	Post Season Ground Transport	194	0.2%	B		X	
	Consultant Travel	179	0.1%	B	X		X
	Interviewing - Travel	41	0.0%	B	X		X
	U Transp Late Cancel	8	0.0%	D		X	
	Trainee Travel	0	0.0%	B	X		X
	U Transp Leases & Rentals	0	0.0%	B		X	
	Other Travel	-21	0.0%	B			X
Plant Operation and Maintenance	Purchased - Electricity	46,066	11.1%	A	X		X
	Equipment Maintenance	43,645	10.5%	B		X	
	Rebilled - Electricity	40,738	9.8%	D			X
	Building Maintenance	37,626	9.1%	B		X	
	CPP - Steam Distribution	23,928	5.8%	D			X
	CPP - Electric Distribution	21,318	5.2%	D			X
	Purchased - Natural Gas	16,825	4.1%	A	X		X
	Rebilled - Water & Sewer	16,677	4.0%	D			X
	Maintenance Contracts	16,589	4.0%	B		X	
	Rebilled - Natural Gas	16,424	4.0%	D			X
	Purchased - Water & Sewer	14,421	3.5%	A		X	
	Construction Services L&M	12,562	3.0%	B		X	
	Maintenance & Repair	10,738	2.6%	B		X	
	Building and Hardware Supplies	10,586	2.6%	B		X	
Facility Maintenance L&M	10,557	2.6%	B		X		

N Campus - Electric Dist	8,353	2.0%	D			X
ISS-CPP Electric Distribution	6,253	1.5%	D			X
Building Services L&M	4,905	1.2%	B		X	
CPP Oper & Maint L&M	4,702	1.1%	B		X	
Safety Equipment & Supplies	4,468	1.1%	B		X	
Plumbing Supplies	4,198	1.0%	B		X	
Hazardous Waste	4,062	1.0%	B		X	
Utilities	3,397	0.8%	B			X
Grounds Labor and Materials	3,106	0.8%	B		X	
Outlying Boiler Services L&M	2,313	0.6%	B		X	
Refuse/Recycle Services L&M	2,206	0.5%	B		X	
CPP Tunnel Crew L&M	2,161	0.5%	B		X	
HVAC Supplies	1,506	0.4%	B		X	
Contractors	1,463	0.4%	C		X	
Parts	1,462	0.4%	C		X	
Door Frames, Locks & Hardware	1,403	0.3%	B		X	
Snow Removal Contractors	1,381	0.3%	A		X	
Util Elec Maint L&M	1,300	0.3%	B		X	
CPP - Steam Dist Sat. Boiler	965	0.2%	D			X
Rubbish Removal	962	0.2%	A		X	
Moving/Trucking L&M	910	0.2%	B		X	
Instrumentation Contracts	713	0.2%	B		X	
High Purity Water	693	0.2%	A		X	
Flooring	687	0.2%	B		X	
Water Treatment	655	0.2%	A		X	
Mover Labor	654	0.2%	A		X	
Mechanical Maint Materials	627	0.2%	B		X	

Purchased - Fuel Oil	609	0.1%	A	X		X
Utilities Administration	589	0.1%	B		X	
Window Cleaning	480	0.1%	B		X	
Lighting Supplies	466	0.1%	B		X	
Landscape Arch & Materials	452	0.1%	B		X	
Filters & Belts	435	0.1%	A		X	
Mover Contractor	429	0.1%	B		X	
Residential Cleaning	366	0.1%	B		X	
Tools	366	0.1%	B		X	
Card Reader Equipment	349	0.1%	B		X	
Instrumentation Materials	341	0.1%	B		X	
Construction Activity	299	0.1%	B		X	
Carpet Cleaning	295	0.1%	B		X	
Carpentry Contractor	273	0.1%	B		X	
Recycling	261	0.1%	A		X	
Paint Supplies	258	0.1%	B		X	
Mason Contractor	239	0.1%	B		X	
Paint Contractor	224	0.1%	B		X	
Pumps	208	0.1%	A		X	
Motors & Drives	200	0.0%	A		X	
Facility Fertilizer&Chemicals	198	0.0%	A		X	
Electrician Contractor	195	0.0%	B		X	
Plumbing Contractor	193	0.0%	B		X	
Elevator Maintenance	187	0.0%	A		X	
Steam Traps	150	0.0%	A		X	
Snow Removal Materials	146	0.0%	B		X	
Customer Fixed Price WR Bills	140	0.0%	B		X	
Outlying Boiler Maintenance	138	0.0%	A		X	
Grounds Maintenance	108	0.0%	B		X	

Horticultural Materials	104	0.0%	B		X	
Rebilled - Fuel Oil	87	0.0%	A	X		X
Other Operations and Maint.	84	0.0%	C		X	
Turf Maintenance	80	0.0%	A		X	
Boiler Contractor	65	0.0%	B		X	
Mason Supplies	61	0.0%	B		X	
Forestry Materials	59	0.0%	B		X	
Util Mech Engr L&M	56	0.0%	B		X	
Facilities & Operations	55	0.0%	B		X	
Mechanical Maint Contracts	48	0.0%	B		X	
Rebilled - Street Lighting	44	0.0%	D			X
Insulation Materials	34	0.0%	B		X	
Purchased - LP Gas	32	0.0%	A	X		X
Irrigation Supplies	30	0.0%	B		X	
Electrician Labor	24	0.0%	A		X	
Mover Supplies	23	0.0%	B		X	
Engr Energy Project Mat	16	0.0%	B		X	
Document Shredding	13	0.0%	B		X	
Boiler Supplies	11	0.0%	B		X	
Rebilled - LP Gas	10	0.0%	D			X
Testing Equip Material/Repairs	10	0.0%	B		X	
Insulation Contractor	9	0.0%	B		X	
Coils	7	0.0%	A		X	
Refrigerant	6	0.0%	A		X	
Gasoline Recharges	5	0.0%	D			X
Trade & Maint Supplies	5	0.0%	B		X	
Plumbing Labor	3	0.0%	A		X	
Carpentry Labor	3	0.0%	A		X	
Paint Labor	1	0.0%	A		X	

	Electrician Supplies	1	0.0%	B		X	
	Carpentry Supplies	0	0.0%	B		X	
	Loss on Defeasance of Debt	0	0.0%	D			X
	Boiler Labor	-3	0.0%	A			X
	Fac & Ops Work Order-Materials	-19	0.0%	B			X
Payments to Auxiliary Activities	Payments to Int. Athletics	2,466	42.7%	D			X
	Payments to Michigan League	1,467	25.4%	D			X
	Payments to Pierpont Commons	1,435	24.8%	D			X
	Payments to University Housing	209	3.6%	D			X
	Payments to Michigan Union	201	3.5%	D			X
Recharge Revenue	Ceded Written Premiums	1,294	-0.2%	D			X
	Training/Consulting Rev	0	0.0%	D			X
	Golf Cart Rental Rev-Internal	-1	0.0%	D			X
	Merchandise Concessions-Internal	-2	0.0%	D			X
	Change in Prepaid Reinsurance	-9	0.0%	D			X
	Copy Machine - Internal	-10	0.0%	D			X
	LP Gas Sales - Internal	-10	0.0%	D			X
	Flowers & Decor - Internal	-14	0.0%	D			X
	Other Facility Rev-Internal	-17	0.0%	D			X
	Document & Imaging Recharge	-19	0.0%	D			X
	BOR Recharge Revenue for B & F	-27	0.0%	D			X

Usage Rev/Green Fees-Internal	-30	0.0%	D			X
Setup - Internal	-35	0.0%	D			X
Sundry Revenue - Internal	-59	0.0%	D			X
LPD Catalog & Conference Rev	-76	0.0%	D			X
Board Revenue - Internal	-133	0.0%	D			X
Project Supply Cost - Internal	-218	0.0%	D			X
Gratuuity - Internal	-511	0.1%	D			X
Equipment Rental - Internal	-516	0.1%	D			X
Change in Unearned Premiums	-736	0.1%	D			X
Off Site Revenue - Internal	-986	0.2%	D			X
Room Revenue - Internal	-1,109	0.2%	D			X
Gate Revenue - Internal	-1,199	0.2%	D			X
On Site Revenue - Internal	-1,978	0.4%	D			X
Conference Meals - Internal	-2,688	0.5%	D			X
Conference Lodging - Internal	-3,684	0.7%	D			X
Parking Permit - Internal	-4,133	0.7%	D			X
Rental Revenue-Internal	-4,978	0.9%	D			X
Unit Designated - Internal	-5,463	1.0%	D			X
Natural Gas Sales - Internal	-16,558	3.0%	D			X
Water,Sewer & Storm - Internal	-16,657	3.0%	D			X
DPSS Recharge Revenue	-20,649	3.7%	D			X
Steam Sales - Internal	-24,892	4.4%	D			X
Electric Sales - Internal	-77,024	13.7%	D			X

	Premium Revenue - Internal	-119,575	21.3%	D			X
	General Recharge Revenue	-258,273	46.0%	D			X

Appendix I: Accounts and Their SEF Assignments

Below is a hyperlink to all U-M spending accounts and their respective SEF assignments made in this study.

[SEF assignments for all accounts](#)