

Recommended Inventory for Data Center Scope 3 GHG Emissions Reporting

White Paper 53

Version 2

Energy Management Research Center

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Executive summary

Many organizations have focused on measuring and reporting Scope 1 and 2 emissions associated with their IT resources and implementing strategies to reduce them. By quantifying Scope 3 emissions from their value chain, organizations can measure their total carbon footprint, including outsourced IT services from cloud and colocation service providers. Organizations can then prioritize their efforts to make impactful carbon reductions. In this paper, we define Scope 3 emissions and propose an inventory of nine emissions source categories and their data center-specific subcategories for accounting and reporting.

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Introduction

Few, if any, organizations¹ today operate without Information Technology (IT). These resources may come in the form of on-premise² data centers, IT equipment in colocation data centers, or IT services from cloud service provider data centers. All of these must be accounted for to report the carbon footprint of your total IT resources. Organizations are making commitments on sustainability as part of their Environmental, Social, and Governance (ESG) programs, and reporting on sustainability as a supplement to financial reporting. **Part of this reporting should include data center emissions**, as explained in White Paper 64, [Why Data Centers Must Prioritize Environmental Sustainability: Four Key Drivers](#).

Many organizations have measured and reported direct emissions from their data center operations (known as Scope 1) and indirect emissions from energy consumption (known as Scope 2). However, accounting for and reporting on indirect emissions from a data center's value chain (known as Scope 3) has been limited due to several challenges such as lack of direct control over value chain activities, lack of reliable supplier data, and **lack of accounting and reporting methodologies**. As a result, Scope 3 emissions disclosures are voluntary while Scope 1 and 2 are mandatory. However, many organizations are starting to realize that knowing their Scope 3 emissions is becoming important for their business. According to an IDC survey report³, 81.5% of respondents across all industries think Scope 3 GHG emissions/energy management is very important or important to their organizations' sustainability initiatives. Meanwhile, **omitting Scope 3 emissions may present potential risks for investors**⁴. We also see the United States is proposing rules to mandate, enhance, and standardize climate-related disclosures including Scope 3⁵. As a result, **we believe that accounting for and reporting on Scope 3 emissions will become mandatory in the near future**.

In fact, Scope 3 emissions can represent the majority of an organization's total carbon footprint. According to the Carbon Disclosure Project (CDP) 2019 global supply chain [report](#), "Although it varies between sectors, on average organizations report having supply chain greenhouse gas emissions that are 5.5 times greater than their own direct impact from scope 1 and 2 emissions." And according to Science-Based Target Initiative (SBTi)⁶ [criteria](#), "If a company has significant scope 3 emissions (over 40% of total scope 1,2 and 3 emissions), it should set a scope 3 target." As more industry consortium are formed such as [Climate Neutral Data Center Pact](#), [Data Center Coalition](#), and [iMasons Climate Accord](#), we believe there will be more consistency in data center Scope 3 emissions accounting and reporting.

We see an increasing number of data center operators setting goals and declaring commitments for Scope 3 emissions reduction. Some examples include:

- "By 2030, we will reduce our Scope 3 emissions by more than half from a 2020 baseline." - Microsoft
- "By 2030, we aim to achieve net-zero emissions across all of our operations and value chain." - Google
- "Reduce Scope 3 emissions by area by 24% by 2030 (against 2018 baseline)." - Digital Realty

¹ In this paper, organizations are public and private companies, government, etc.

² This means the data centers are owned and operated by the organizations themselves.

³ IDC, [Global Sustainable Strategies and Technologies Buyer Value Survey, 2022 – Part 1: Overall Priorities](#), Doc # US48708622, February 2022.

⁴ <https://www.gbm.hsbc.com/en-gb/feed/sustainability/scope-3-emissions> Accessed on Sep. 20, 2022

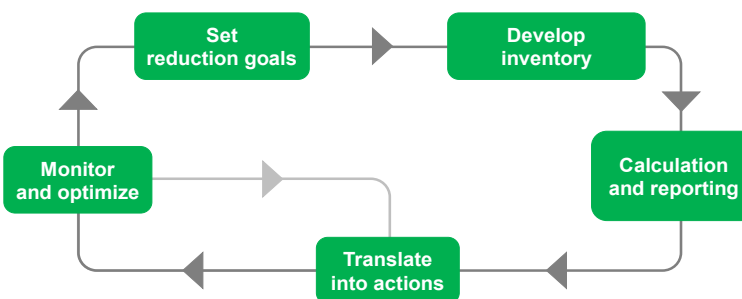
⁵ <https://www.sec.gov/news/press-release/2022-46> Accessed on Sep. 20, 2022

⁶ This is a collaboration between Carbon Disclosure Project (CDP), World Resource Institute (WRI), World Wide Fund for Nature (WWF), and United Nations Global Compact (UNGC).

Figure 1 shows a typical process for reducing data center Scope 3 emissions. In this paper we focus on the “develop inventory” step. We define Scope 3 emissions and two emissions accounting and allocation rules. We propose and define an inventory of nine source categories and their data center-specific subcategories.

Figure 1

Steps to reduce data center Scope 3 emissions



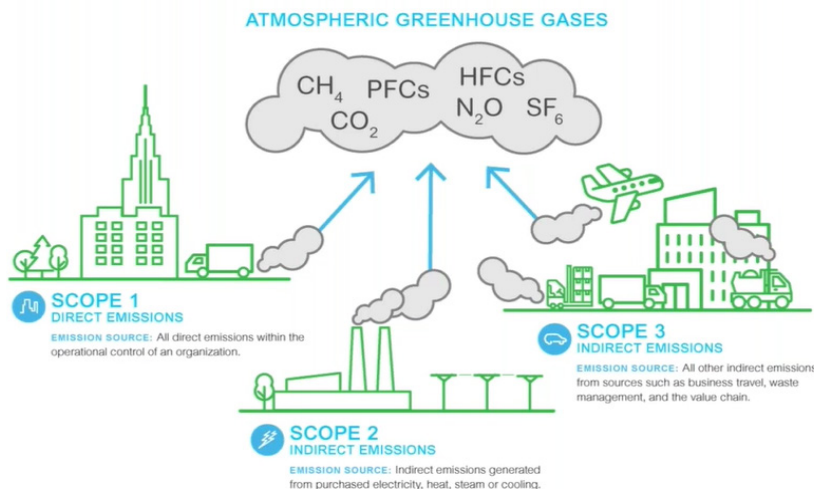
Defining Scope 3 GHG emissions

To accurately account for and report on Scope 3 emissions, we need to understand the differences between Scope 1, 2, and 3 (see Figure 2). Greenhouse gas⁷ means “any of the various gaseous compounds that absorb infrared radiation, trap heat in the atmosphere, and contribute to the greenhouse effect”⁸. According to the [GHG Protocol](#) and [ISO 14064](#), the three GHG emissions categories are:

- **Scope 1 - Direct GHG emissions:** All direct emissions within the operational control of an organization (e.g., operating diesel generators onsite).
- **Scope 2 - Indirect energy GHG emissions:** Indirect emissions generated from purchased or acquired electricity, heat, steam, or cooling.
- **Scope 3 - Other indirect GHG emissions:** All other indirect emissions from sources such as business travel, waste management, manufacture of the products you buy across the value chain.

Figure 2

3 categories of GHG emissions



Based on categories above, we see the total carbon footprint of an organization includes carbon emissions not only from its own operations (Scope 1) and energy consumption (Scope 2), but also the emissions from its value chain (Scope 3), covering all emissions related to an organization’s activities. Of these three, Scope 3 are the most difficult to assess because the data is more difficult to attain.

⁷ According to the “[Framework Convention on Climate Change](#)” and “[Kyoto Protocol](#)”, there are six main greenhouse gases: Carbon dioxide (CO₂); Methane (CH₄); Per-fluorocarbons (PFCs); Hydrofluorocarbons (HFCs); Nitrous oxide (N₂O); and Sulfur hexafluoride (SF₆).

⁸ <https://www.merriam-webster.com/dictionary/greenhouse%20gas>

Rules for emissions accounting and allocation

Organizations need to identify the operational boundaries⁹ between them and their suppliers / partners / customers across the value chain to correctly account for and allocate carbon emissions. There are two critical rules for accomplishing this:

- 1. Scope 1, 2, and 3 are mutually exclusive for an organization** - If the emissions are already accounted in Scope 1 or 2 of an organization, they can't be accounted in its Scope 3, to avoid double counting. For example, the indirect emissions from electricity consumption are categorized as and accounted for as the consumer's Scope 2 emissions, and therefore, cannot be accounted as purchased product or services in its Scope 3 emissions.
- 2. The same emissions can be double counted between organizations** - The emissions of one organization can be allocated to another organization if they have related business activities. For example, a manufacturer's emissions from producing a product can be allocated to the customer who buys that product as upstream Scope 3 emissions.

Identifying the operational boundaries and allocating emissions between organizations is a challenge. **Developing a Scope 3 emissions inventory to cover most source categories is key to solving this challenge.** Furthermore, **standardizing an inventory plays an important role in reporting, benchmarking, and achieving an organization's net-zero carbon sustainability goal.**

GHG Protocol inventory for Scope 3 accounting and reporting

The World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) have developed an inventory with 15 source categories for Scope 3 accounting and reporting (as shown in **Table 1**). These categories include upstream and downstream business activities common to many organizations.

No.	Category	
1		Purchased goods and services
2		Capital goods
3		Fuel- and energy-related activities not included in Scope 1 and Scope 2
4	Upstream	Upstream transportation and distribution
5		Waste generated in operations
6		Business travel
7		Employee commuting
8		Upstream leased assets
9		Downstream transportation and distribution
10		Processing of sold products
11	Downstream	Use of sold products
12		End of life of sold products
13		Downstream leased assets
14	Franchises	
15	Investments	

Table 1

Inventory of activities for Scope 3 emissions reporting recommended by WRI and WBCSD

Source: [Technical Guidance for Calculating Scope 3 Emissions](#)

⁹ According to GHG Protocol, operational boundaries mean, "The boundaries that determine the direct and indirect emissions associated with operations owned or controlled by the reporting company". For example, understanding upstream vendors and downstream customers is important to correctly account for and allocate the Scope 3 emissions across the value chain.

It's not surprising that this inventory applies broadly, and therefore not all 15 categories are relevant to an organization's IT resources emissions, such as use of sold products, end of life of sold products, franchises, and investments. In the next section, we narrow these categories and propose data center-relevant subcategories for each.

Recommended inventory for IT resources

According to [SBTi](#), "The scope 3 target boundary should include the majority of value chain emissions, for example, the top three emissions source categories or two-thirds of total scope 3 emissions." However, organizations in the early stage of their Scope 3 journey sometimes make the mistake of reporting on source categories with easy-to-attain data, such as business travel and employee commuting. The emissions normally represent a small percentage of total Scope 3 emissions, leading to the misconception that Scope 3 represents a small portion of the total carbon footprint of an organization. In this section, we propose source categories with IT resource-specific subcategories for Scope 3 emissions accounting and reporting. We selected and recommended these source categories based on the following 8 rules:

- Consistent with GHG Protocol standards and guidance¹⁰
- Relevant to an organization's IT resources
- Emissions from the source category can't be negligible
- Covers emissions from both on-premise and outsourced IT resources
- Covers most of the Scope 3 emissions for an organization's IT resources
- Can be quantified
- Applies to all geographies (i.e. regions, countries, etc.)
- Actionable (can easily be translated into actions to make improvements)

As a result of following these rules, we narrowed the 15 GHG Protocol inventory categories to nine key categories and proposed IT resources-specific subcategories for each (as shown in **Table 2**). Organizations can use these categories to account for and report on their IT resources Scope 3 emissions year over year¹¹. The emissions from these categories should be calculated based on reliable data sources in each reporting year. Note that for organizations that don't own any on-premise data centers, the most important categories for them are listed under three categories and their proposed subcategories:

- No. 1 Purchased good and services - Cloud services
- No. 8 Upstream leased assets - Leased colocation data center space
- No. 9 Downstream leased assets - Multi-tenant & single-tenant data centers

The following subsections define each category and describe their application.

¹⁰ It includes [Corporate Accounting and Reporting Standard](#), [Corporate Value Chain \(Scope 3\) Standard](#), and [Technical Guidance for Calculating Scope 3 Emissions](#).

¹¹ Note that the emissions from the production of capital goods, or from the materials of core & shell are only accounted and reported in the acquisition or construction year and should not be depreciated or amortized over time like financial accounting.

Table 2

Nine key source categories with IT resources-specific subcategories for Scope 3 emissions reporting

No.	Category	Proposed subcategories
1	Purchased goods and services	<ul style="list-style-type: none"> Core & shell (materials) Cloud services
2	Capital goods	<ul style="list-style-type: none"> IT equipment Power equipment Cooling equipment Others (i.e. rack, fire protection, lighting)
3	Fuel- and energy-related activities ¹²	<ul style="list-style-type: none"> Fuels (i.e. diesel, natural gas) Energy (i.e. electricity, cooling)
4	Upstream transportation and distribution	<ul style="list-style-type: none"> Shipments via road, rail, air, and marine
5	Waste generated in operations	<ul style="list-style-type: none"> Solid waste management Wastewater management
6	Business travel	<ul style="list-style-type: none"> Air, rail, bus, and automobile travel Hotel night stays
7	Employee commuting	<ul style="list-style-type: none"> Automobile travel Public transport Others (e.g. telecommuting)
8	Upstream leased assets	<ul style="list-style-type: none"> Leased vehicles Leased buildings Leased colocation data center space (i.e. U-space, rack-space, IT room, or even the whole data center)
9 ¹³	Downstream leased assets	<ul style="list-style-type: none"> Multi-tenant data centers Single-tenant data centers

Accounting for three types of IT resources

This inventory applies to all organizations that depend on IT to run their business. We categorized IT resources into three main categories:

- Data center facilities owned and operated by your organization (i.e., on-premise)
- IT equipment housed within a colocation facility
- Cloud services, hosted applications, etc.

To report the carbon footprint of all your IT resources, you must account for the carbon emissions from all three categories that apply to your organization. Table 2 allows you to properly categorize and report your emissions from different sources. In addition to categorizing the emissions from your own data centers, your

¹² The emissions are not included in Scope 1 and Scope 2.

¹³ Category's original number in the GHG inventory is 13, but we renumbered it as 9 to avoid confusion.

colocation / cloud service providers should provide you with the emissions related to your outsourced IT services.

Definition and application for each category

Purchased goods and services - Category 1

Definition - These emissions include cradle-to-gate carbon footprint, from raw material extraction, to manufacturing, to the factory gate before transportation and use by consumers. For example, the emissions from the production of construction materials for data center core & shell, such as concrete, metals, wood, and plastics. *Emissions from core & shell are accounted in the construction year and should not be depreciated or amortized over time like financial accounting.* For purchased services, the emissions include the carbon footprint to produce and deliver the services. For example, the emissions from outsourced cloud services. The cloud providers should calculate the carbon footprint of their cloud services with appropriate categories recommended in **Table 2** and allocate the emissions to their customers per their IT usage.

Application - Reporting on and tracking this source brings transparency to the carbon footprint of their goods and/or services supply chain, helping make procurement improvements, and develop plans to work with contractors and suppliers to reduce emissions. One aspect to note: the impact from core & shell is highly variable due to the fluctuating number of facilities built in a given year and should be called out when reporting. Purchasing low-carbon construction materials or repurposing existing structures is an effective approach to reduce this impact.

Capital goods - Category 2

Definition - Upstream capital goods (also known as capital assets) typically have long lives. Examples of capital goods include switchgear and transformers (20-30 year lifetime) and servers (3-5 year lifetime). This includes cradle-to-gate (*factory gate*) emissions similar to purchased goods. *Note that the emissions from capital goods should not be depreciated or amortized over the life of the assets like financial accounting, and the total cradle-to-gate emissions are accounted and reported in the acquisition year.* When equipment reaches the end of life, it will be replaced with new equipment, whose new emissions should be accounted for and reported in the replacement year. Organizations (i.e., colocation tenants) also need to include the emissions of their IT equipment that are housed in colocation data centers as part of their total data center carbon footprint.

Application - It can help organizations bring transparency to the carbon footprint of their capital goods supply chain. The impact from this source represents the majority of emissions within an organization's value chain, but the impact from capital goods is also highly variable due to the fluctuating quantity of purchased equipment in a given year. When assessing procurement activities, cradle-to-gate emissions of the equipment should be considered and solutions to reduce or eliminate this source should be implemented. Scope 3 transparency and targets should be part of the procurement process of capital goods. This facilitates the development of action plans with equipment suppliers to reduce this impact.

Fuel- and energy-related activities - Category 3

Definition - Includes upstream emissions of purchased and consumed fuels and energy that are not included in Scope 1 or Scope 2. For fuels, the upstream emissions include resource extraction, production, transportation, and distribution of the fuels. For example, when purchasing diesel fuel, Scope 3 emissions are accounted for, and when the fuel is burned, Scope 1 emissions are accounted for. For energy

generation, the upstream emissions include pre-combustion emissions (extraction, production, and transportation of fuel used to generate the energy) and transmission and distribution losses. For example, according to the U.S. Energy Information Administration (EIA), the transmission and distribution losses of electricity is around 5% of the transmitted and distributed electricity¹⁴. The direct emissions from a gen-set's fuel combustion belong to Scope 1 while the indirect emissions from energy usage belong to Scope 2. *Note that if these emissions are already included in Scope 1 or 2, they should not be accounted for in Scope 3 to avoid double counting according to the first accounting and allocation rule.*

Application - Although Scope 1 and Scope 2 cover the majority of emissions from fuel and energy consumption, reporting on and tracking this source can help organizations bring transparency to the total carbon footprint of their fuel- and energy-related activities for the purpose of making procurement improvements to reduce this impact. *Note that there are two approaches for electricity emissions accounting including location-based and market-based, which may have different precombustion emissions, transmission, and distribution losses.*¹⁵

Upstream transportation and distribution - Category 4

Definition - Includes upstream emissions due to transportation and distribution of acquired goods. Specifically, the emissions from the transportation and distribution between a data center organization's suppliers and data center sites, and also the emissions from third-party transportation and distribution services. For example, emissions from a shipment of racks from an integrator to the data center site. It also includes emissions from inbound and outbound vehicles within a data center organization. *Note that the emissions from transportation and distribution during manufacturing process belong to category 1 or category 2.*

Application - Reporting on and tracking this source can help organizations to implement transportation and distribution strategies to reduce this impact. This can include things like aggregating shipments to reduce the number of deliveries to more accurate forecasting to reduce air shipments.

Waste generated in operations - Category 5

Definition - Includes upstream emissions from third-party disposal and treatment of waste generated in operations. For example, the emissions from disposal and treatment activities such as landfills, recycling, and incineration of the equipment when they reach end of life. *Note that if the organization disposes of the waste itself, the related emissions may likely be Scope 1, not Scope 3 (Category 5).*

Application - More recycling services could lead to higher emissions of this category, but likely reduces emissions by reusing components, such as servers and batteries. As the industry matures, we expect these emissions will be "refunded" in the future for embodied carbon in products.

¹⁴ <https://www.eia.gov/tools/faqs/faq.php?id=105&t=3>

¹⁵ Location-based means the emissions are calculated based on the average emissions intensity of grids in the data center location, within a defined geographic area and a defined time period. Market-based means the emissions calculation considers contractual arrangements under which the data center procures power from specific sources, such as renewable energy. For more information on the definitions and applications of location-based and market-based carbon emissions, see white paper 67, [Guide to Environmental Sustainability Metrics for Data Centers](#).

Business travel - Category 6

Definition - Includes emissions from employee transportation for business-related activities. For example, it includes emissions from transportation carriers (i.e., airlines, car rentals), and hotel night stays.

Application - All organizations have made great strides since 2020 to prioritize remote meetings over business travel, first for safety, then for cost efficiency. Understanding the Scope 3 impact of business travel will allow organizations to continue to make informed decisions and reduce this category.

Employee commuting - Category 7

Definition - Includes emissions from the transportation of employees between their homes and their worksites. For example, it includes emissions of fuels or energy used by vehicles owned and operated by the employees or transportation providers. If employees work from home, the related emissions should also be included and accounted for as telecommuting.

Application - Tracking this can help data center organizations develop programs to reduce this impact such as leasing green bus services or allowing employees to work from home.

Upstream leased assets - Category 8

Definition - Includes emissions from upstream leased assets that are not included in Scope 1 or Scope 2. For example, the emissions from the operation of leased data centers will be categorized here. Organizations (lessees) who lease data center space from colocation providers (lessors) should account for the emissions from these leased data center spaces. These organizations should ask their colocation providers to provide accurate carbon emissions data based on their usage.

Application - Tracking and reporting on emissions from leased data center space not only helps establish the total data center carbon footprint but also encourages the procurement of colocation services with lower carbon footprint.

Downstream leased assets - Category 9

Definition - Includes emissions from downstream leased assets that are not included in Scope 1 or Scope 2. This category is specific for colocation providers (lessors) who lease their data center space to organizations (lessees). Colocation providers need to identify the operational boundaries and allocate carbon emissions to their tenants per their usage.

Application - By tracking and reporting this source, colocation providers can meet their tenants' emissions requirements, and in turn, the tenants can add these emissions as part of their total IT resources carbon footprint.

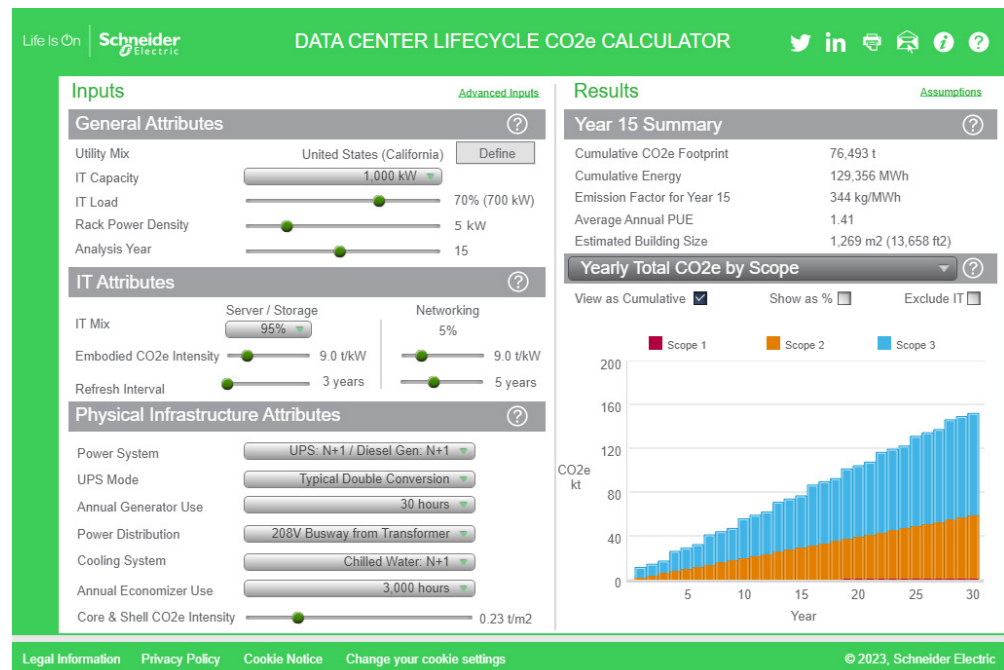
By breaking down Scope 3 emissions into these 9 categories, companies can more easily identify sources and improve accuracy for improvement and reporting.

A tool used for quantification

Quantifying the total carbon footprint and composition between categories allows you to identify and address the source of the most significant emissions. Doing this may be overwhelming for some organizations. In these cases, we recommend using third-party consultant services experienced in the sustainability field, preferably with experience in data centers, such as Schneider Electric. Based on over ten years of Schneider Electric consultant experience, we have developed a TradeOff Tool, “[Data Center Lifecycle CO₂e Calculator](#)” (Figure 3), which can help estimate the emissions of each category based on different inputs. For guidance on estimating a data center’s Scope 3 emissions, see White Paper 99, [Quantifying Data Center Scope 3 GHG Emissions to Prioritize Reduction Efforts](#).

Figure 3

[Data Center Lifecycle CO₂e Calculator](#)



Conclusion

Understanding Scope 3 emissions will help organizations bring transparency to their value chain's carbon footprint, identify emissions-reduction opportunities, and prioritize reduction efforts. Going forward, it's important for companies to fully understand all sustainability aspects of their IT operations. Carving out the IT operations sustainability data and then reporting on it is quite challenging. To make matters worse, frameworks for reporting Scope 3 emissions, such as GHG Protocol, are vague and not useful for reporting on IT resources. An additional challenge is that IT resources can be distributed across on-premise data centers, colocation data centers, and IT services from cloud service providers. Tracking and reporting Scope 3 GHG emissions must include cloud and colocation service providers for accurate allocation of carbon emissions.

We have taken GHG Protocol's high level, standardized Scope 3 framework and broken the nine general categories down into more granular categories applicable to IT reporting. This will assist companies in identifying their Scope 3 emissions from all of their IT operations. Using this framework will help develop complete, accurate, and consistent Scope 3 emissions accounting and reporting. A consistent reporting framework for IT across all organizations is crucial in order to benchmark and ultimately achieve net-zero carbon sustainability goals.







About the authors

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