The Carbon Accounting Company™

2022 and 2023 Greenhouse Gas Emissions Inventory
prepared for
documenta and Museum Fridericianum gGmbH

February 22, 2024

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Dear Martin,

It is my pleasure to present this quantification of greenhouse gas emissions resulting from the documenta Exhibition of Contemporary Art and related operations and exhibitions of the Documenta organization ("Documenta") for 2022 and 2023.

Our review of the data is based solely on our assessment of the information provided to us by Documenta.

Based on the information provided, the emissions as reported in this document are credible and defensible as an attempt to quantify the emissions sources and resultant emissions levels for the sources provided.

If you have any questions, please do not hesitate to contact me at 416.494.9999 ext.15 or ian@thecarbonaccountingcompany.com.

Yours sincerely,

Ian Lipton
President & CEO

The Carbon Accounting Company™

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1 Introduction

The Documenta organization ("Documenta"), through Art into Acres, retained The Carbon Accounting Company ("TCAC") to quantify the greenhouse gas (GHG) emissions resulting from the *documenta Exhibition of Contemporary Art* and related operations and exhibitions for the calendar years 2022 and 2023. This engagement was funded by Art into Acres.

The goal of this project is to provide Documenta quantifiable information that will support them in reducing the global warming impact associated with their annual operations and the *documenta Exhibition* that takes place every 5 years through ongoing climate change mitigation strategies including land conservation projects.

It should be noted that the terms "carbon footprint", "GHG inventory", and "emissions inventory" are used interchangeably. They all refer to the same thing, which is the quantity of greenhouse gas emissions caused by the activities associated with Documenta's operations.

The primary greenhouse gases in this inventory are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). While carbon (C) occurs in only two of these three gases, it is standard practice to include at least all three gases in most organizational carbon footprints as these three gases are the main drivers of global warming and the catastrophic climate crisis we are facing.

The carbon dioxide, methane, and nitrous oxide emissions are quantified and converted into an equivalent amount of carbon dioxide (CO2e) based on the global warming potentials of each of the three gases. This is standard practice in all organizational carbon footprints. More on this procedure can be found in Section 3.1 General Methodology.

2 Scope of the Study

2.1 Quantification Boundaries

This carbon footprint is limited to the GHG emissions generated from activities that occurred during the 2022 and 2023 periods of operations.

The organizational boundaries for this carbon footprint quantification follow the Operational Control approach. Under this approach, only business operations over which Documenta has operational control are included in this inventory. 100% of the emissions from those operations are aggregated.

Documenta has operational control over the following three buildings:

- Museum Fridericianum
- Doc Halle
- UK 8

An example of emissions from an organization that would fall outside operational control are the business operations of a supplier that is neither owned nor operated by Documenta. However, if that supplier is hired to provide services onsite at Documenta, the carbon associated from those activities would be included in this carbon footprint. For example, the emissions from energy used by a supplier, such as a carpenter, while working onsite to install an exhibition would be included in this footprint. However, the energy used in the carpenter's workshop would not be included.

This carbon footprint consists of emissions generated from operational activities classified as Scope 1 and 2. Scope 3 activities were beyond the scope of this project. These standard classification categories refer to the direct or indirect nature of the emissions causality.

Scope 1 activities are those that create emissions directly within the organizational boundaries. Examples include any combustion of fuel to heat buildings/power generators, or fuel used in vehicles operated by the organization.

Scope 2 activities are those that create emissions indirectly from the purchase of energy used within the organizational boundaries. An example is the emissions generated from the use of electricity. While the actual emissions occur at the electricity generating facility, which is outside Documenta's operational control, the electricity used by Documenta is within their operational control.

Table 1 lists all activities considered in this inventory.

Table 1. GHG Inventory Boundaries and Activities

Scope 1	Stationary combustion of fossil fuels for heating buildings and water: BUILDINGS ARE HEATED USING DISTRICT ENERGY Mobile combustion of fossil fuels used in Documenta's operated road vehicles and off-road vehicles Combustion of fossil fuels used in backup generators: THERE ARE NO GENERATORS AT THE FACILITIES Fugitive emissions from air conditioning and refrigeration units
Scope 2	Purchased electricity Purchased district energy (i.e., hot water)

2.2 Exclusions

It is standard practice in carbon accounting to set a de-minimis threshold below which certain activities may be excluded from the inventory. In this case, activities that were deemed to contribute less than 1% of the overall carbon footprint were excluded, unless the data were readily available.

3 Methodology and Assumptions

3.1 General Methodology

This emissions quantification follows the principles and methods of The GHG Protocol Corporate Accounting and Reporting Standard (https://ghgprotocol.org/corporate-standard).

Emissions factors can differ from region to region because of variations in the carbon content of local fuels, differences in the sources of electricity feeding local utility grids, and differences in the accounting practices of jurisdictional authorities. For this inventory, we used electricity emissions factors provided by the Association of Issuing Bodies (AIB), an association of European issuers of Guarantees of Origin certificates, which measures the amount of power produced at particular power plants. We also used the emissions factors provide by the UK's Department for Business, Energy & Industrial Strategy for the combustion of fossil fuels and the generation of hot water in district power plants, and the US Environmental Protection Agency for the emissions factors associated with fugitive gases from air conditioning and refrigeration units.

Emissions were calculated as follows:

3.1.1 Stationary and mobile combustion of fossil fuels

Three main greenhouse gases from mobile combustion – carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) – were quantified and converted into carbon dioxide equivalents (CO2e) as follows:

$$CO2e = \sum [\, Q_{ft} \times (CO2_{EF\,ft} + (CH4_{EF\,ft})(CH4_{GWP}) + (N2O_{EF\,ft})(N2O_{GWP})) \,]_{ft}$$

where,

Q_{ft} = quantity of fuel type used

$CO2_{EF\,ft}$ = carbon dioxide emissions factor for fuel type

$CH4_{EF\,ft}$ = methane emissions factor for fuel type

$CH4_{GWP}$ = methane global warming potential

$N2O_{EF\,ft}$ = nitrous oxide emissions factor for fuel type

$N2O_{GWP}$ = nitrous oxide global warming potential

ft = fuel type

All fuel emissions factors were "tank-to-wheels" (meaning upstream emissions from fuel production were omitted) and were sourced from UK Department for Business, Energy & Industrial Strategy.

3.1.2 Purchased electricity

Documenta draws electricity from the local utility grid, much of which is purchased under any renewable energy contract.

As per standard practice under The GHG Protocol, both the location-based and market-based electricity emissions methods were used. The location-based method is based on all the fuel types used to generate electricity on the local grid ("production fuel mix").

The market-based method is based on the fuel types that have not already been attributed to renewable energy contracts from the local grid ("residual fuel mix"). These residual fuel mix emissions factors were sourced from the Association of Issuing Bodies (AIB) (version 1.0, 2023-06-01).

Three main greenhouse gases from the generation of electricity – carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) – were quantified and converted into carbon dioxide equivalents (CO_2e) as follows:

Location-Based Method:

$$CO_2e = \sum [E_{\text{local grid}} \times (CO_{2\ \text{EF local grid}} + (CH_{4\ \text{EF local grid}})(CH_{4\ \text{GWP}}) + (N_2O_{\text{EF local grid}})(N_2O_{\text{GWP}}))]_{\text{local grid}}$$

where,

$E_{\text{local rid}}$ = kilowatt-hours (kWh) of electricity drawn from local grid

$CO_{2\ \text{EF local grid}}$ = carbon dioxide emissions factor for local grid (production fuel mix factor)

$CH_{4\ \text{EF local grid}}$ = methane emissions factor for local grid (production fuel mix factor)

$CH_{4\ \text{GWP}}$ = methane global warming potential

$N_2O_{\text{EF local grid}}$ = nitrous oxide emissions factor for local grid (production fuel mix factor)

N_2O_{GWP} = nitrous oxide global warming potential

local grid = electricity grid on which each building is located

Electricity grid emissions factors were sourced from Association of Issuing Bodies (AIB) (version 1.0, 2023-06-01).

Market-Based Method:

$$CO_2e = \sum [E_{\text{purchased}} \times (CO_{2\ \text{EF purchased}} + (CH_{4\ \text{EF purchased}})(CH_{4\ \text{GWP}}) + (N_2O_{\text{EF purchased}})(N_2O_{\text{GWP}}))]_{\text{purchased}}$$

where,

$E_{\text{purchased}}$ = kilowatt-hours (kWh) of electricity purchased from local grid

$CO_{2\ \text{EF purchased}}$ = carbon dioxide emissions factor for electricity purchased (residual fuel mix factor)

$CH_{4\ \text{EF purchased}}$ = methane emissions factor for electricity purchased (residual fuel mix factor)

$CH_{4\ \text{GWP}}$ = methane global warming potential

$N_2O_{\text{EF purchased}}$ = nitrous oxide emissions factor for electricity purchased (residual fuel mix factor)

N_2O_{GWP} = nitrous oxide global warming potential

purchased = electricity purchase contract

Electricity residual fuel mix emissions factors were sourced Association of Issuing Bodies (AIB) (version 1.0, 2023-06-01).

3.1.3 Purchased hot water

Three main greenhouse gases from the generation of hot water through district energy distribution – carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) – were quantified and converted into carbon dioxide equivalents (CO2e) as follows:

$$CO2e = \sum [HW_{purchased} \times (CO2_{EF\ purchased} + (CH4_{EF\ purchased})(CH4_{GWP}) + (N2O_{EF\ purchased})(N2O_{GWP}))]_{purchased}$$

where,

$HW_{purchased}$ = kilowatt-hours (kWh) of hot water purchased from local district energy network

$CO2_{EF\ purchased}$ = carbon dioxide emissions factor for hot water purchased

$CH4_{EF\ purchased}$ = methane emissions factor for hot water purchased

$CH4_{GWP}$ = methane global warming potential

$N2O_{EF\ purchased}$ = nitrous oxide emissions factor for hot water purchased

$N2O_{GWP}$ = nitrous oxide global warming potential

purchased = hot water purchase contract

District hot water emissions factors were sourced from UK Department for Business, Energy & Industrial Strategy.

3.1.4 Fugitive emissions from air conditioning and refrigeration units

Greenhouse gases from air conditioning and refrigeration units were quantified and converted into carbon dioxide equivalents (CO2e) following the US EPA Source Level Refrigeration Gas CO2 Equivalent Emissions - Screening Method.

3.2 Emissions Factors and Global Warming Potentials

Unless otherwise stated, all emissions calculations were based on the from UK Department for Business, Energy & Industrial Strategy, 2022 and 2023 versions referenced in the sections above.

3.3 Assumptions

Shared Space:

- Documenta shares approximately 8% of the building space in Museum Fridericianum with another organization. It is assumed the additional energy consumption from the use of that space is negligible to Documenta's overall carbon footprint.

Data Collection:

- All data were collected and provided by Documenta personnel either directly in the data collection workbook provided by The Carbon Accounting Company, or in separately consolidated formats. It is assumed that the data entered by Documenta personnel were accurate and complete.

4 Results

Table 2. Emissions Sources: 2022

2022	Museum Fridericianum	Doc Halle	UK 8	Total
Scope 1				
Stationary Combustion	-	-	-	-
Mobile Combustion: Diesel	4,458 Litres	-	-	4,458 Litres
Air Conditioning	R407C, R410A, R32	-	-	R407C, R410A, R32
Scope 2				
Grid Electricity (residual mix)	253,637 kWh	-	-	253,637 kWh
Grid Electricity (renewables)	116,267 kWh	137,266 kWh	8,414 kWh	261,947 kWh
Purchased Hot Water	892 MWh	455 MWh	43 MWh	1,390 MWh

Table 3. Emissions Sources: 2023

2023	Museum Fridericianum	Doc Halle	UK 8	Total
Scope 1				
Stationary Combustion	-	-	-	-
Mobile Combustion: Diesel	707 Litres	-	-	707 Litres
Air Conditioning	R407C, R410A, R32	-	-	R407C, R410A, R32
Scope 2				
Grid Electricity (residual mix)	217,812 kWh	-	-	217,812 kWh
Grid Electricity (renewables)	116,022 kWh	58,772 kWh	8.902 kWh	183,696 kWh
Purchased Hot Water	848 MWh	321 MWh	43 MWh	1,212 MWh

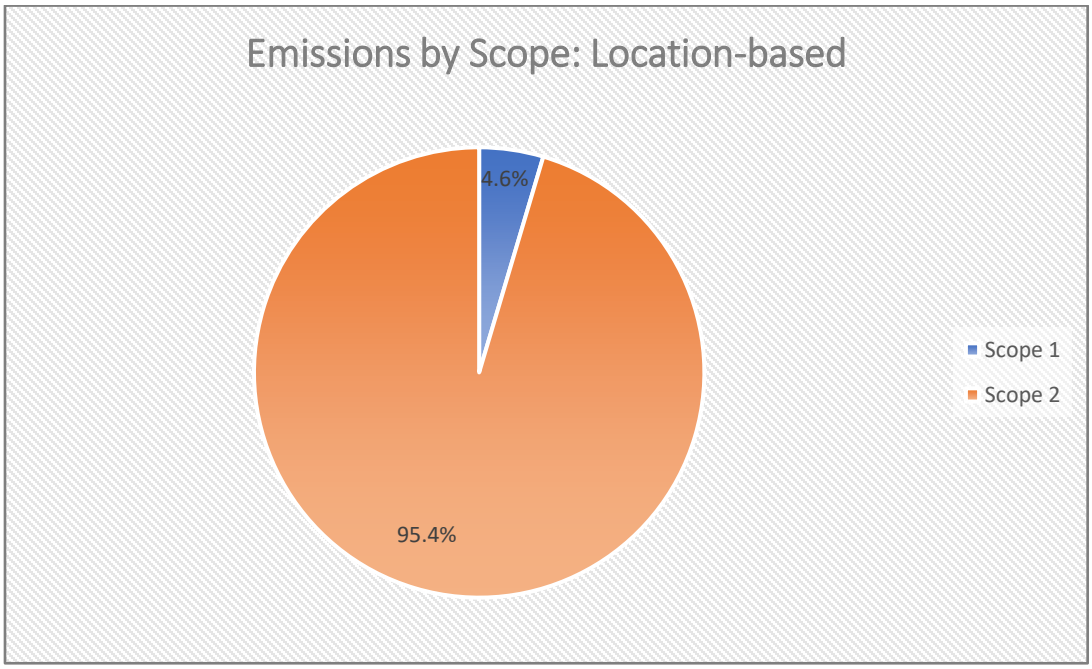
Table 4. Greenhouse Gas Emissions: 2022

2022 Total	Location-based method	Market-based method
Scope 1	kg CO2e	kg CO2e
Stationary Combustion	-	-
Mobile Combustion: Diesel	12,031	12,031
Fugitive Emissions from Air Conditioning	7,485	7,485
Total Scope 1	19,516	19,516
Scope 2	kg CO2e	kg CO2e
Grid Electricity	168,153	173,495
Purchased Hot Water	237,305	237,305
Total Scope 2	405,458	410,800
Total Emissions (kg CO2e)	424,974	430,316
Total Emissions (tonnes CO2e)	**425.0**	**430.3**

Table 5. Greenhouse Gas Emissions: 2023

2023 Total	Location-based method	Market-based method
Scope 1	kg CO2e	kg CO2e
Stationary Combustion	-	-
Mobile Combustion: Diesel	1,880	1,880
Fugitive Emissions from Air Conditioning	3,227	3,227
Total Scope 1	5,107	5,107
Scope 2	kg CO2e	kg CO2e
Grid Electricity	130,949	148,990
Purchased Hot Water	217,821	217,821
Total Scope 2	348,770	366,811
Total Emissions (kg CO2e)	353,877	371,918
Total Emissions (tonnes CO2e	**353.9**	**371.9**

Figure 1. Emissions by Scope: 2022



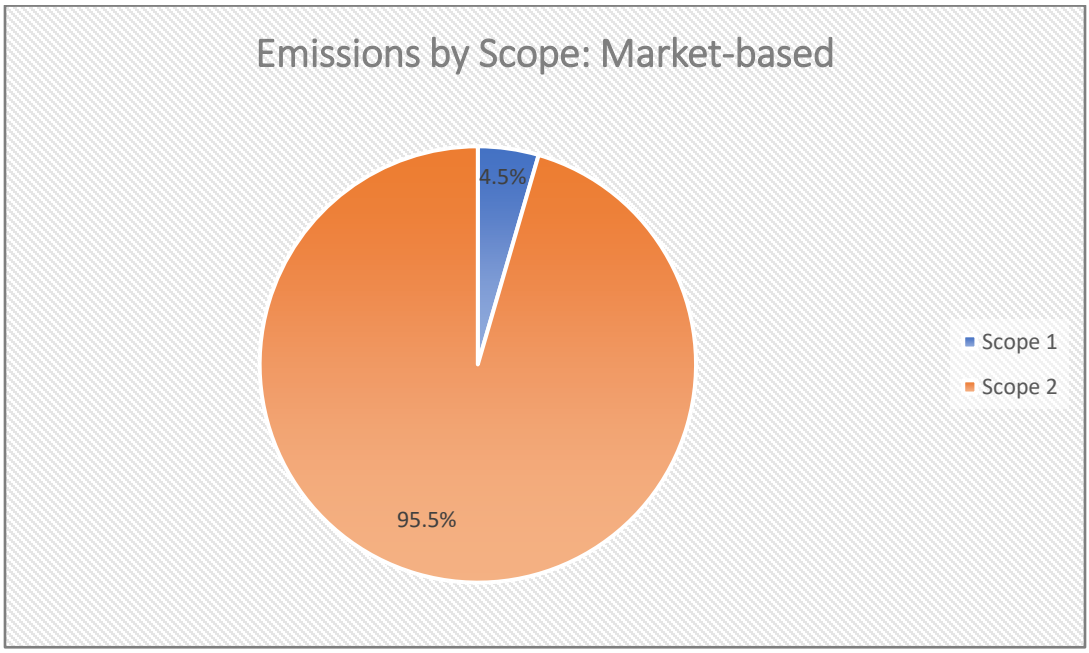


Figure 2. Emissions by Scope: 2023

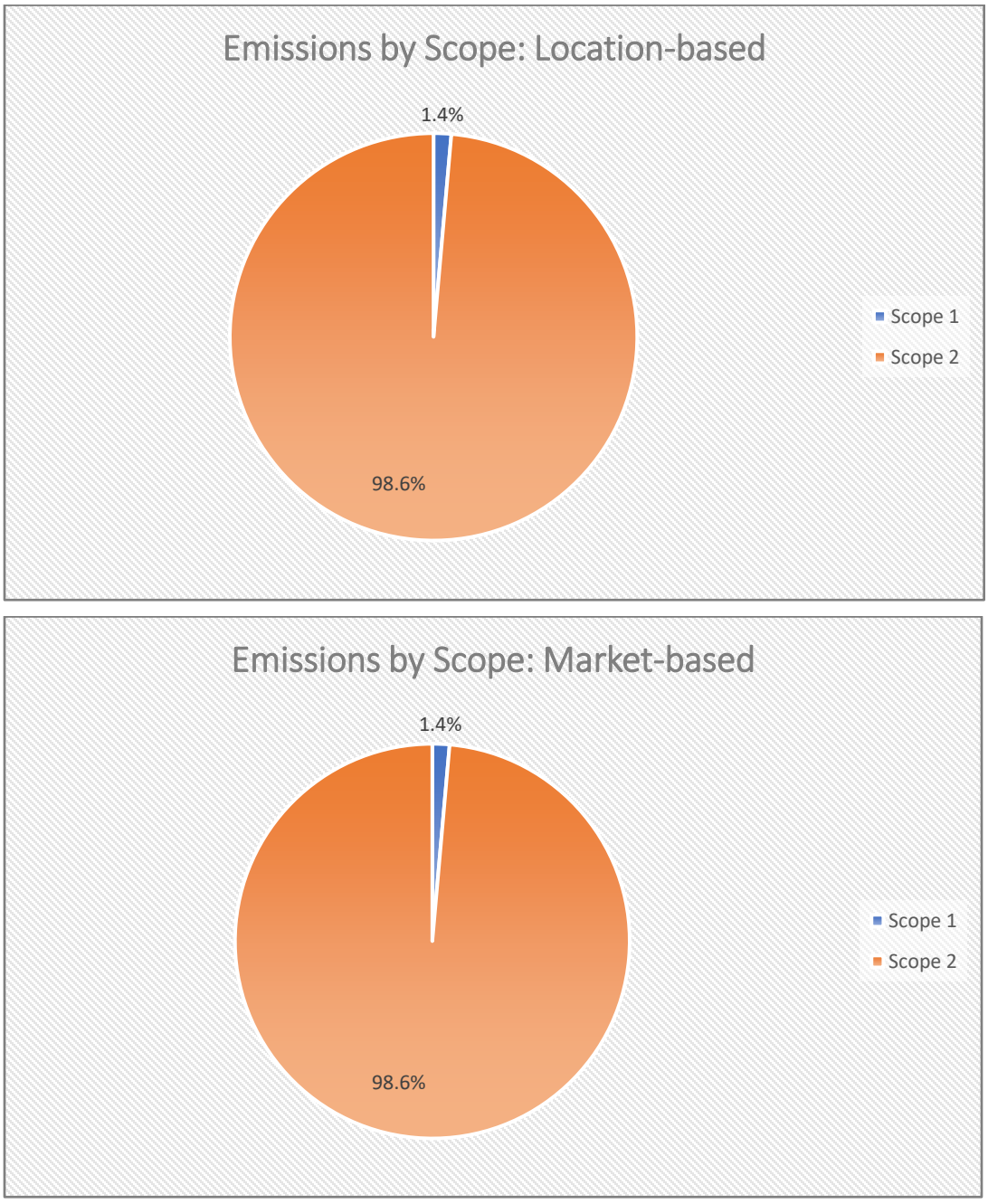
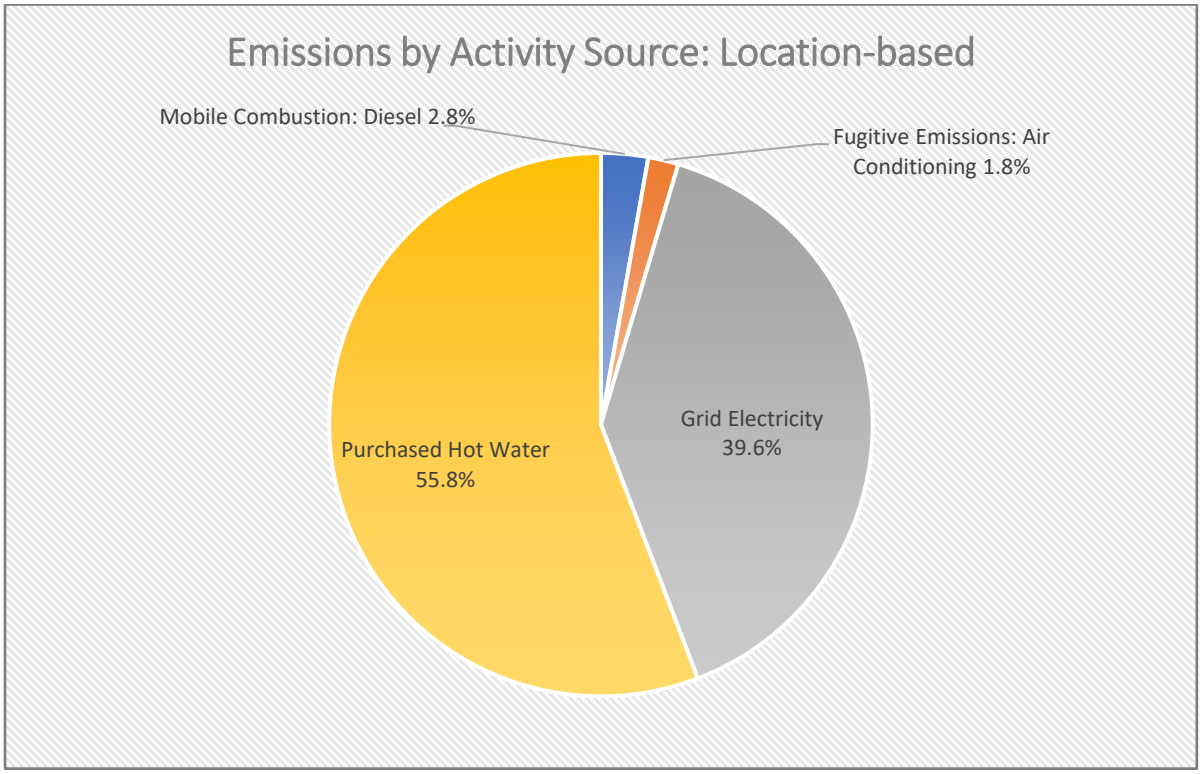


Figure 3. Emissions by Activity Source: 2022



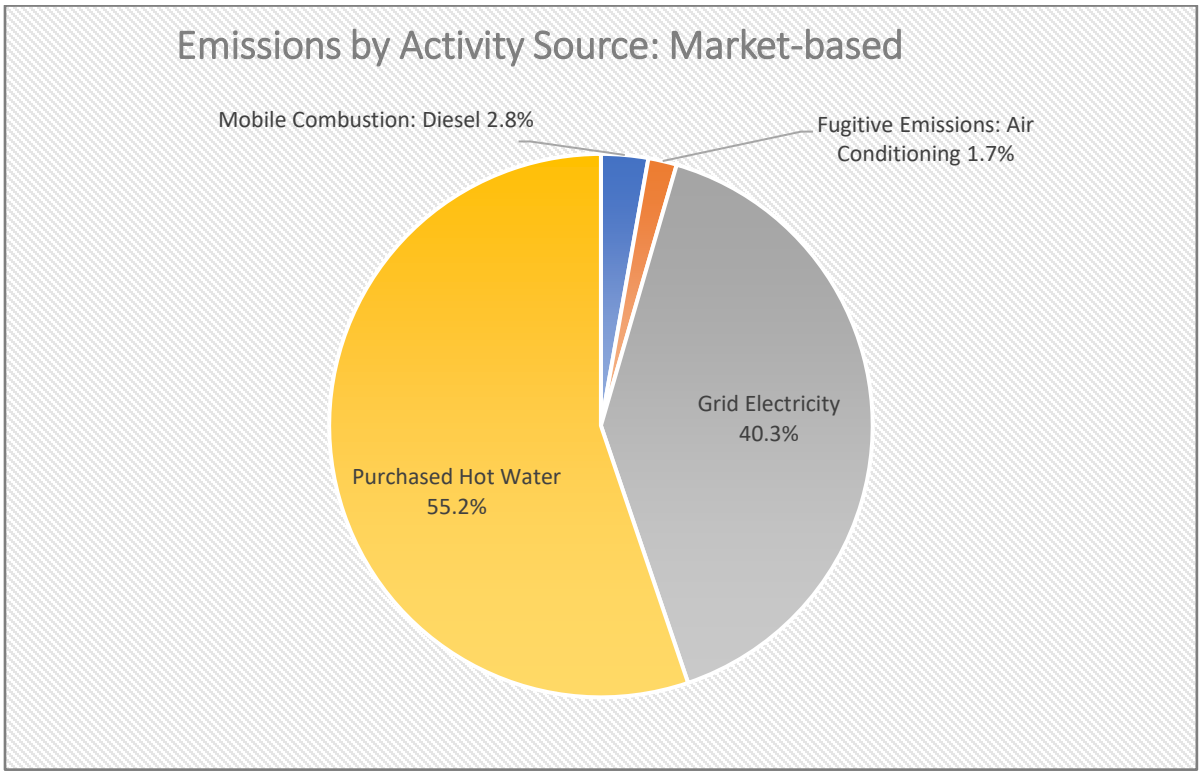
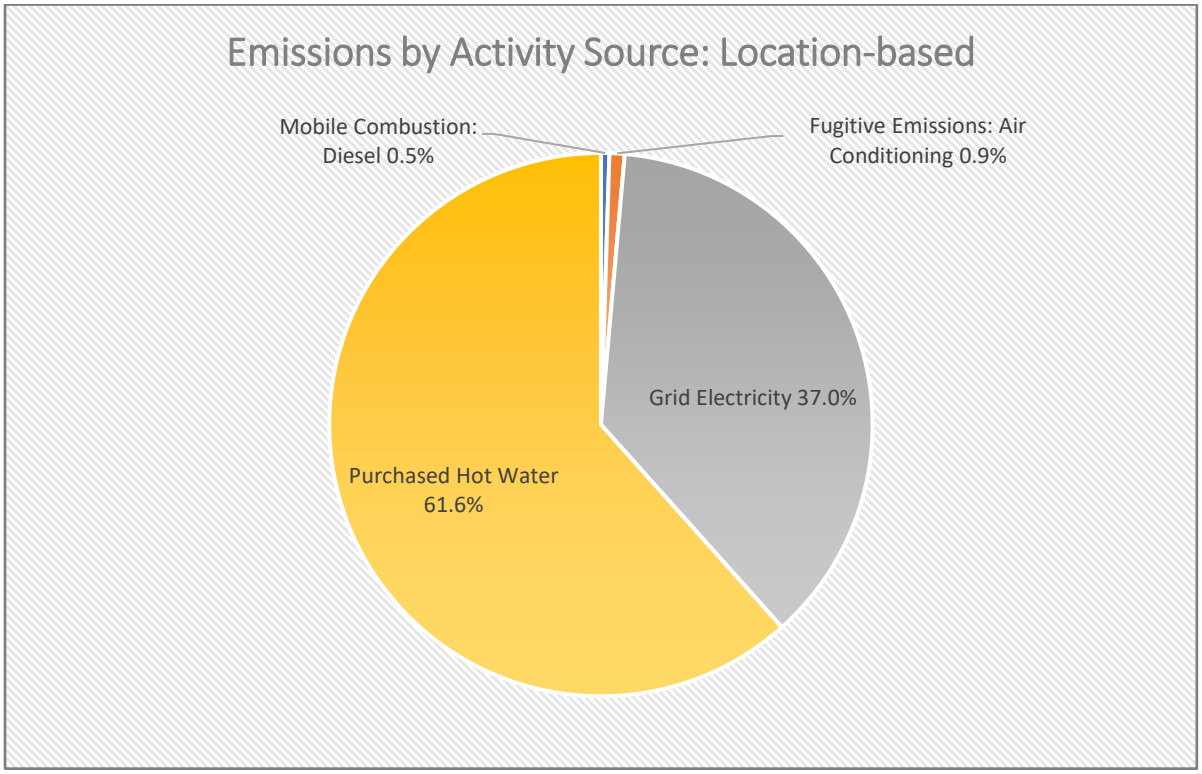


Figure 4. Emissions by Activity Source: 2023



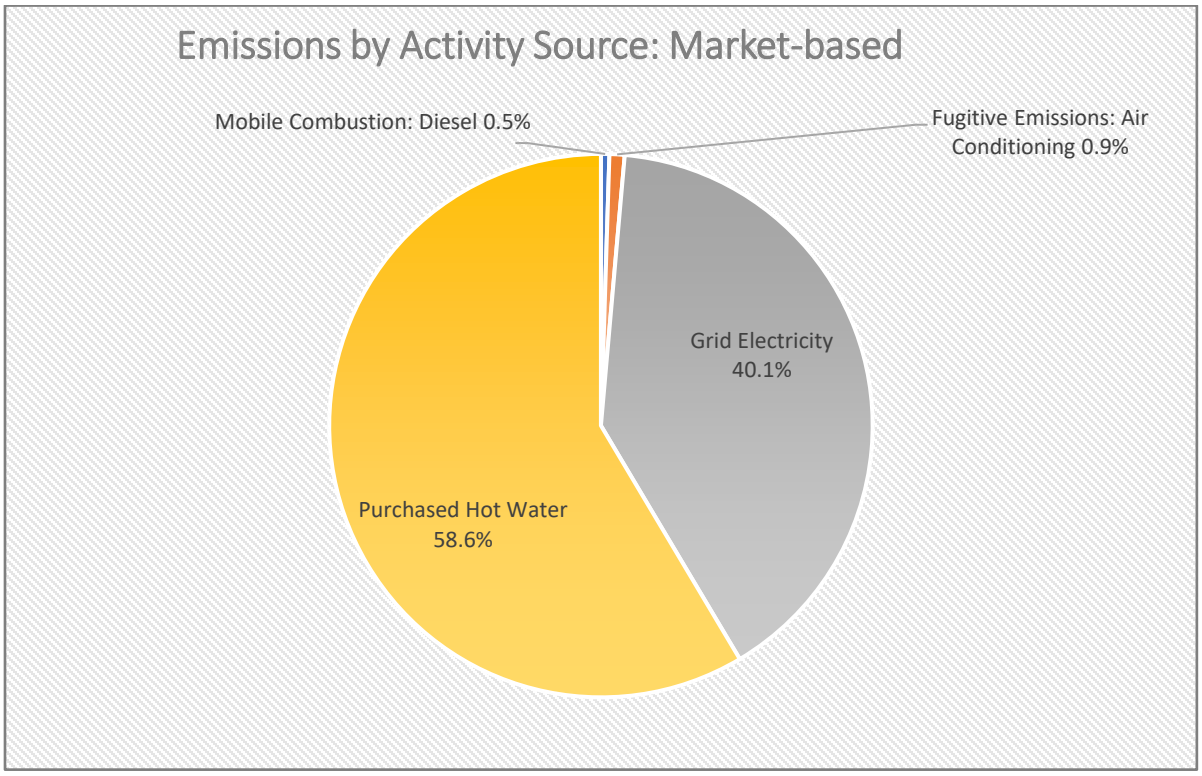


Table 6. Greenhouse Gas Emissions Year-over-Year: Market-based Method

	2022	2023	Percent Change
Scope 1	kg CO2e	kg CO2e	
Stationary Combustion	-	-	-
Mobile Combustion: Diesel	12,031	1,880	-84.4%
Fugitive Emissions from Air Conditioning	7,485	3,227	-56.9%
Total Scope 1	19,516	5,107	-73.8%
Scope 2	kg CO2e	kg CO2e	
Grid Electricity	173,495	148,990	-14.1%
Purchased Hot Water	237,305	217,821	-8.2%
Total Scope 2	410,800	366,811	-10.7%
Total Emissions (kg CO2e)	430,316	371,918	
Total Emissions (tonnes CO2e	**430.3**	**371.9**	**-13.6%**

5 Statement of Accuracy

The Carbon Accounting Company states that, based on the information provided, the emissions associated with Documenta's operations as reported in this document are credible and defensible as an attempt to quantify the emissions sources and resultant emissions levels for the sources provided.

For more information regarding this report, please contact:

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