IBM z16™ multi frame

Product Carbon Footprint

IBM® is committed to environmental leadership in all its business activities, from operations to the design of its products and use of its technology. To help our clients better understand the environmental impacts associated with IBM products, we report the product carbon footprint for representative products.

IBM z16™ multi frame configuration	
CPC drawer	
Module DCM, all cores active	4
PCIe Fan Out Gen 4	3
Integrated Coupling Adapter SR	3
Frame without covers	1
Wooden Shipping Crate	1
PCIe+ I/O drawer	
FICON Express32S LX	8
OSA-Express7S 10 GbE LR	6
Coupling Express2 LR	1
Crypto Express8S (2 HSM)	1
PCIe Interconnect Gen4	2
Support Element	
1U Server Support Element	1
Ethernet Switch	
24-port Ethernet Switch	1

Table 1: *Typical product configuration*

IBM z16™ multi frame

CPC Drawer Product Carbon Footprint

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IBM z16™ multi frame CPC drawer configuration	
Module DCM, all cores active	4
PCIe Fan Out Gen 4	3
Integrated Coupling Adapter SR	3
Frame without Covers	1
Wooden Shipping Crate	1

Table 2: *Typical CPC drawer product configuration*

The estimate

86,000

kg CO2e[1]

This number is the estimated mean GHG emissions in carbon dioxide equivalent associated with the manufacturing, assembly, electricity consumption[2], transportation and end-of-life handling of the IBM z16™ multi frame CPC drawer over 5 years using hypothetical average GHG emissions factors for the European Union.

This PCF estimate was produced using the Product Attributes to Impact Algorithm (PAIA) model, developed by the Massachusetts Institute of Technology's Materials Systems Laboratory and partners, Version 1.3.2, January 10, 2023, copyright by the ICT Benchmarking collaboration including the Massachusetts Institute of Technology's Materials Systems Laboratory and partners.

All estimates of carbon footprint are uncertain. For this product, the estimate has a mean of 86,000 kg CO_2e and a standard deviation of 47,000 kg CO_2e (86,000 ± 47,000 kg CO_2e) over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. IBM also reports the 95th percentile of the carbon footprint estimate, which is 244,000 kg CO_2e over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. The 95th percentile means that 5% of the time the carbon footprint will exceed the value provided.

Impact by phases of the product's lifecycle
The PCF for server equipment is largely driven by the use phase which is highly variable based on the electricity generation source used to power the product, the expected use life of the product, and the power profile. This PCF was generated using a distribution of emissions factors across the European Union. The analysis for this product shows that 74.9% of its carbon footprint occurs in the use phase. IBM focuses on improving our product energy efficiency and on providing mechanisms for our clients to measure the actual energy consumption of the product.

Figure 1 shows the estimated mean contribution for the individual phases of the product's lifecycle over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. Figure 2 shows the uncertainty in the product's carbon footprint. The blue bar representing the mean and one standard deviation and the error bars representing the 5th and 95th percentile of the carbon footprint estimate.

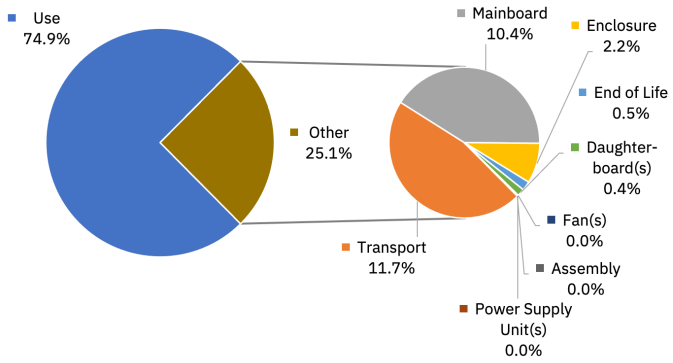

Figure 1: *Carbon footprint impact by phase for the IBM z16™ multi frame CPC drawer typical product configuration listed in Table 2 using the PAIA model; 74.9% occurs in the use phase and the remaining 25.1% is broken out.*

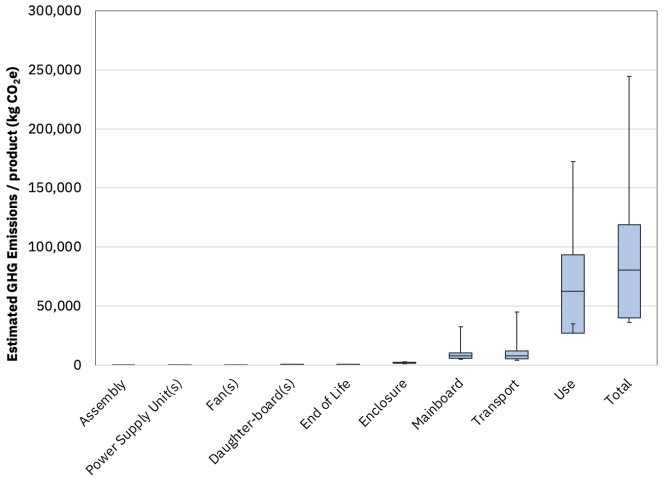

Figure 2: *Uncertainty in the PCF estimate for the IBM z16™ multi frame CPC drawer typical product configuration listed in Table 2; the estimate has a total mean of 86,000 ± 47,000 kg CO_2e over a use period of 5 years.*

IBM z16™ multi frame

PCIe+ I/O Drawer Product Carbon Footprint

IBM® is committed to environmental leadership in all its business activities, from operations to the design of its products and use of its technology. To help our clients better understand the environmental impacts associated with IBM products, we report the product carbon footprint for representative products.

IBM z16™ multi frame PCIe+ I/O drawer configuration	
FICON Express32S LX	8
OSA-Express7S 10 GbE LR	6
Coupling Express2 LR	1
Crypto Express8S (2 HSM)	1
PCIe Interconnect Gen4	2

Table 3: *Typical PCIe+ I/O drawer product configuration*

The estimate

18,000

kg CO2e[1]

This number is the estimated mean GHG emissions in carbon dioxide equivalent associated with the manufacturing, assembly, electricity consumption[2], transportation and end-of-life handling of the IBM z16™ multi frame PCIe+ I/O drawer over 5 years using hypothetical average GHG emissions factors for the European Union.

This PCF estimate was produced using the Product Attributes to Impact Algorithm (PAIA) model, developed by the Massachusetts Institute of Technology's Materials Systems Laboratory and partners, Version 1.3.2, January 11, 2023, copyright by the ICT Benchmarking collaboration including the Massachusetts Institute of Technology's Materials Systems Laboratory and partners.

All estimates of carbon footprint are uncertain. For this product, the estimate has a mean of 18,000 kg CO_2e and a standard deviation of 20,000 kg CO_2e (18,000 ± 20,000 kg CO_2e) over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. IBM also reports the 95th percentile of the carbon footprint estimate, which is 126,000 kg CO_2e over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. The 95th percentile means that 5% of the time the carbon footprint will exceed the value provided.

Impact by phases of the product's lifecycle
The PCF for server equipment is largely driven by the use phase which is highly variable based on the electricity generation source used to power the product, the expected use life of the product, and the power profile. This PCF was generated using a distribution of emissions factors across the European Union. The analysis for this product shows that 79.2% of its carbon footprint occurs in the use phase. IBM focuses on improving our product energy efficiency and on providing mechanisms for our clients to measure the actual energy consumption of the product.

Figure 3 shows the estimated mean contribution for the individual phases of the product's lifecycle over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. Figure 4 shows the uncertainty in the product's carbon footprint. The blue bar representing the mean and one standard deviation and the error bars representing the 5th and 95th percentile of the carbon footprint estimate.

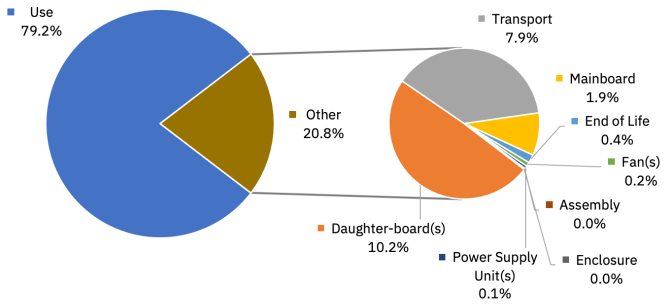

Figure 3: *Carbon footprint impact by phase for the IBM z16™ multi frame PCIe+ I/O drawer typical product configuration listed in Table 3 using the PAIA model; 79.2% occurs in the use phase and the remaining 20.8% is broken out.*

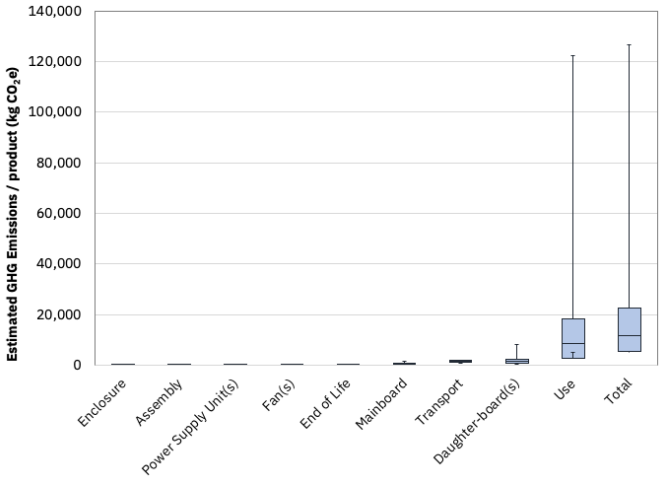

Figure 4: *Uncertainty in the PCF estimate for the IBM z16™ multi frame PCIe+ I/O drawer typical product configuration listed in Table 3; the estimate has a total mean of 18,000 ± 20,000 kg CO_2e over a use period of 5 years.*

IBM z16™ multi frame

Support Element Product Carbon Footprint

IBM® is committed to environmental leadership in all its business activities, from operations to the design of its products and use of its technology. To help our clients better understand the environmental impacts associated with IBM products, we report the product carbon footprint for representative products.

IBM z16™ multi frame Support Element configuration	
1U Server Support Element	1

Table 4: *Typical Support Element product configuration*

The estimate

3,000

kg CO2e[1]

This number is the estimated mean GHG emissions in carbon dioxide equivalent associated with the manufacturing, assembly, electricity consumption[2], transportation and end-of-life handling of the IBM z16™ multi frame Support Element over 5 years using hypothetical average GHG emissions factors for the European Union.

This PCF estimate was produced using the Product Attributes to Impact Algorithm (PAIA) model, developed by the Massachusetts Institute of Technology's Materials Systems Laboratory and partners, Version 1.3.2, January 11, 2023, copyright by the ICT Benchmarking collaboration including the Massachusetts Institute of Technology's Materials Systems Laboratory and partners.

All estimates of carbon footprint are uncertain. For this product, the estimate has a mean of 3,000 kg CO_2e and a standard deviation of 2,000 kg CO_2e (3,000 ± 2,000 kg CO_2e) over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. IBM also reports the 95th percentile of the carbon footprint estimate, which is 9,000 kg CO_2e over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. The 95th percentile means that 5% of the time the carbon footprint will exceed the value provided.

Impact by phases of the product's lifecycle
The PCF for server equipment is largely driven by the use phase which is highly variable based on the electricity generation source used to power the product, the expected use life of the product, and the power profile. This PCF was generated using a distribution of emissions factors across the European Union. The analysis for this product shows that 77.2% of its carbon footprint occurs in the use phase. IBM focuses on improving our product energy efficiency and on providing mechanisms for our clients to measure the actual energy consumption of the product.

Figure 5 shows the estimated mean contribution for the individual phases of the product's lifecycle over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. Figure 6 shows the uncertainty in the product's carbon footprint. The blue bar representing the mean and one standard deviation and the error bars representing the 5th and 95th percentile of the carbon footprint estimate.

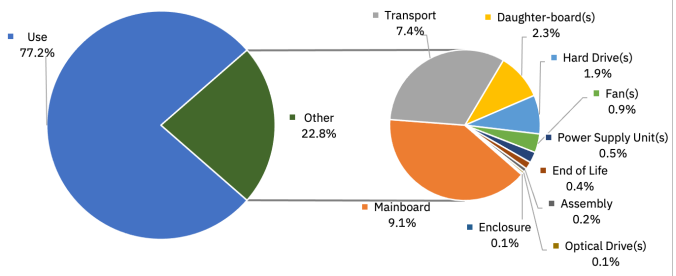

Figure 5: *Carbon footprint impact by phase for the IBM z16™ multi frame Support Element typical product configuration listed in Table 4 using the PAIA model; 77.2% occurs in the use phase and the remaining 22.8% is broken out.*

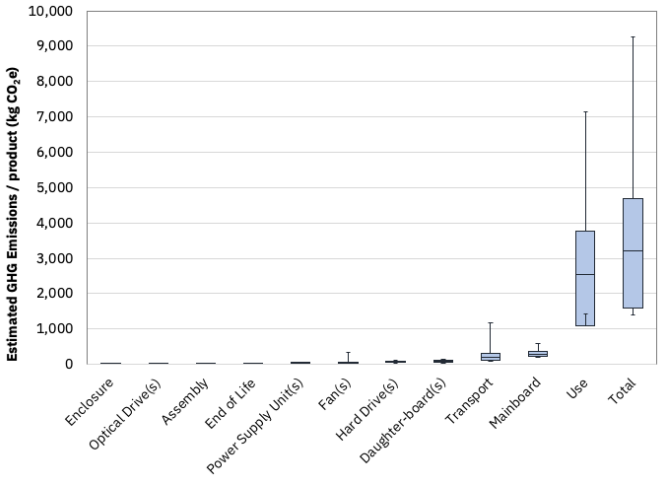

Figure 6: *Uncertainty in the PCF estimate for the IBM z16™ multi frame Support Element typical product configuration listed in Table 4; the estimate has a total mean of 3,000 ± 2,000 kg CO_2e over a use period of 5 years.*

IBM z16™ multi frame

24-port Ethernet Switch Product Carbon Footprint

IBM® is committed to environmental leadership in all its business activities, from operations to the design of its products and use of its technology. To help our clients better understand the environmental impacts associated with IBM products, we report the product carbon footprint for representative products.

IBM z16™ multi frame 24-port Ethernet Switch configuration	
24-port Ethernet Switch	1

Table 5: *Typical 24-port Ethernet Switch product configuration*

The estimate

3,000

kg CO2e[1]

This number is the estimated mean GHG emissions in carbon dioxide equivalent associated with the manufacturing, assembly, electricity consumption[2], transportation and end-of-life handling of the IBM z16™ multi frame 24-port Ethernet Switch over 5 years using hypothetical average GHG emissions factors for the European Union.

This PCF estimate was produced using the Product Attributes to Impact Algorithm (PAIA) model, developed by the Massachusetts Institute of Technology's Materials Systems Laboratory and partners, Version 1.3.2, January 11, 2023, copyright by the ICT Benchmarking collaboration including the Massachusetts Institute of Technology's Materials Systems Laboratory and partners.

All estimates of carbon footprint are uncertain. For this product, the estimate has a mean of 3,000 kg CO_2e and a standard deviation of 2,000 kg CO_2e (3,000 ± 2,000 kg CO_2e) over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. IBM also reports the 95th percentile of the carbon footprint estimate, which is 7,000 kg CO_2e over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. The 95th percentile means that 5% of the time the carbon footprint will exceed the value provided.

Impact by phases of the product's lifecycle
The PCF for server equipment is largely driven by the use phase which is highly variable based on the electricity generation source used to power the product, the expected use life of the product, and the power profile. This PCF was generated using a distribution of emissions factors across the European Union. The analysis for this product shows that 93.9% of its carbon footprint occurs in the use phase. IBM focuses on improving our product energy efficiency and on providing mechanisms for our clients to measure the actual energy consumption of the product.

Figure 7 shows the estimated mean contribution for the individual phases of the product's lifecycle over a use period of 5 years using hypothetical average GHG emissions factors for the European Union. Figure 8 shows the uncertainty in the product's carbon footprint. The blue bar representing the mean and one standard deviation and the error bars representing the 5th and 95th percentile of the carbon footprint estimate.

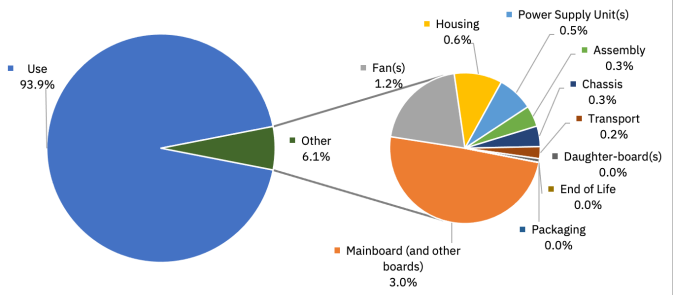

Figure 7: *Carbon footprint impact by phase for the IBM z16™ multi frame 24-port Ethernet Switch product configuration listed in Table 5 using the PAIA model; 93.9% occurs in the use phase and the remaining 6.1% is broken out.*

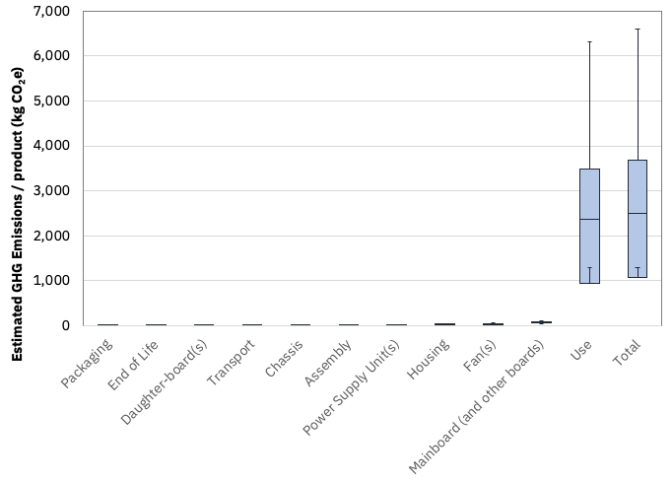

Figure 8: *Uncertainty in the PCF estimate for the IBM z16™ multi frame 24-port Ethernet Switch typical product configuration listed in Table 5; the estimate has a total mean of 3,000 ± 2,000 kg CO_2e over a use period of 5 years.*

PAIA input assumptions

The PCF assumes a typical configuration of the product as described in Table 1. The numbers for your specific configuration might be different. The data used in the PAIA server tool is provided in Table 6 for the IBM z16™ multi frame CPC drawer.

PAIA input information[3]	
Server type	Rack
Server quantity	1
Number of PSU	4
Number of fans	5
Server weight	83.0 kg
Rack weight	115.7 kg
Packaging weight	247.2 kg
Motherboard	
PWB area	2374.6 cm^2
CPU quantity	4
CPU package area	56.4 cm^2
DRAM total capacity	3.58 TB
Chipset & other ICs package area	Default
Chipset & other ICs quantity	Default
Storage	
SSD quantity	N/A
SSD PWB area	N/A
SSD IC area total	N/A
SSD IC quantity	N/A
Daughterboards	
Sub card total PWB area	2842.6 cm^2
Sub card main chip package area	251.5 cm^2
Sub card chip count	91
PSU	
PSU weight	1.13 kg
PSU dimensions	19.2 x 10.0 cm
Optical disk drives	
ODD quantity	N/A
Use[4]	
Product lifetime	5 years
Yearly energy consumption	25447 kWh
Location	
Assembly location	United States
Use location	Europe
Transportation	
To country of use by air	6120 km
Within country of use by truck	300 km
End of life	
Fraction recycled	0.97
Fraction shredded recycling	0.00

Table 6: *PAIA input information for the IBM z16™ multi frame CPC drawer*

The data used in the PAIA server tool is provided in Table 7 for the IBM z16™ multi frame PCIe+ I/O drawer.

PAIA input information[5]	
Server type	Rack
Server quantity	1
Number of PSU	2
Number of fans	6
Server weight	90.7 kg
Rack weight	N/A
Packaging weight	N/A
Motherboard	
PWB area	2164.0 cm^2
CPU quantity	0
CPU package area	N/A
DRAM total capacity	N/A
Chipset & other ICs package area	Default
Chipset & other ICs quantity	Default
Storage	
SSD quantity	N/A
SSD PWB area	N/A
SSD IC area total	N/A
SSD IC quantity	N/A
Daughterboards	
Sub card total PWB area	19515.9 cm^2
Sub card main chip package area	520.9 cm^2
Sub card chip count	110
PSU	
PSU weight	1.04 kg
PSU dimensions	20.0 x 10.0 cm
Optical disk drives	
ODD quantity	N/A
Use[4]	
Product lifetime	5 years
Yearly energy consumption	5676 kWh
Location	
Assembly location	United States
Use location	Europe
Transportation	
To country of use by air	6120 km
Within country of use by truck	300 km
End of life	
Fraction recycled	0.97
Fraction shredded recycling	0.00

Table 7: *PAIA input information for the IBM z16™ multi frame PCIe+ I/O drawer*

The data used in the PAIA server tool is provided in Table 8 for the IBM z16™ multi frame Support Element.

PAIA input information[6]	
Server type	Rack
Server quantity	1
Number of PSU	2
Number of fans	5
Server weight	16.0 kg
Rack weight	N/A
Packaging weight	N/A
Motherboard	
PWB area	791.1 cm^2
CPU quantity	1
CPU package area	14.1 cm^2
DRAM total capacity	0.032 TB
Chipset & other ICs package area	15.8 cm^2
Chipset & other ICs quantity	5
Storage	
HDD quantity	1
HDD form factor	2.5
HDD IC area total	N/A
HDD IC quantity	N/A
Daughterboards	
Sub card total PWB area	863.9 cm^2
Sub card main chip package area	0.0 cm^2
Sub card chip count	1
PSU	
PSU weight	0.89 kg
PSU dimensions	19.4 x 8.0 cm
Optical disk drives	
ODD quantity	1
Use[4]	
Product lifetime	5 years
Yearly energy consumption	1051 kWh
Location	
Assembly location	United States
Use location	Europe
Transportation	
To country of use by air	6120 km
Within country of use by truck	300 km
End of life	
Fraction recycled	0.97
Fraction shredded recycling	0.00

Table 8: *PAIA input information for the IBM z16™ multi frame Support Element*

The data used in the PAIA network tool is provided in Table 9 for the IBM z16™ multi frame 24-port Ethernet Switch.

PAIA input information[6]	
Form factor	Rack
Product weight	3.3 kg
Packaging weight	N/A
Chassis weight	2.6 kg
Number of switches	1
Rack weight	N/A
Motherboard	
PWB area	0.061 m^2
CPU quantity	1
CPU package area	7.3 cm^2
DRAM total capacity	1 GB
Chipset & other ICs count	4
Chipset & other ICs area	2.9 cm^2
Sub boards	
Sub card total PWB area	0.001 m^2
Sub card main chip package area	0.001 cm^2
Sub card chip count	1
PSU	
PSU count	1
PSU weight	0.19 kg
PSU dimensions	12.7 x 7.6 cm
Fan Tray	
Fan count	1
Ports	
Port count	24
Use[4]	
Product lifetime	5 years
Yearly energy consumption	964 kWh
Location	
Use location	Europe
Transportation	
To country of use by air	6120 km
Within country of use by truck	300 km

Table 9: *PAIA input information for the IBM z16™ multi frame 24-port Ethernet Switch*

Limitations of PAIA

PAIA results represent a streamlined Life Cycle Assessment (LCA). While the product carbon footprint provides a high- level estimate of the emissions associated with the product, it should not be used for emissions inventory, formal carbon foot printing exercises or comparing products. LCA results are strongly influenced by the assumptions made by the analyst; if those assumptions are inconsistent, comparisons are not likely meaningful. Furthermore, PAIA may not be compliant with the primary data requirements of some LCA standards. The results from the PAIA tools are liable to change over time as the methodology is improved and data is updated. More information on these limitations, as well as general guidance for interpreting this report, is available in the publication "Assessment of lifecycle carbon footprints of products"

Disclaimers

[1] The results are reported using the units of kilograms of carbon dioxide equivalent (kg CO_2e). This represents the amount of global warming caused by a quantity of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) at a specific point in time, expressed in terms of the amount of CO_2 which would have the same instantaneous warming effect. Recognizing the uncertainty in carbon footprint estimates, the results have been rounded to the nearest thousand.

[2] The electricity consumption is incurred by clients using an IBM product. The estimate used is not specific to any client deployment of the IBM product or client workload.

[3] The estimated carbon footprint was computed including the system frame and shipping crate. The estimated carbon footprint for the CPC drawer without the frame and shipping crate has a mean of 74,000 kg CO_2e and a standard deviation of 45,000 kg CO_2e (74,000 ± 45,000 kg CO_2e).

[4] Power consumption data is obtained using the IBM Power Estimation Tool for the IBM z16™ multi frame, a web-based tool for estimating power requirements for the IBM z16™ multi frame. This tool estimates the typical power requirements for the specific configuration listed in Table 1 under Normal operating conditions. The power consumption assumes that the product operates 24 hours a day, 365 days a year for its product lifetime.

[5] The estimated carbon footprint was computed without the system frame and shipping crate. The carbon footprint of the system frame and shipping crate are included in the carbon footprint report for the IBM z16™ multi frame CPC drawer. The estimated carbon footprint for the PCIe+ I/O drawer with the frame and shipping crate has a mean of 29,000 kg CO_2e and a standard deviation of 19,000 kg CO_2e (29,000 ± 19,000 kg CO_2e).

[6] The estimated carbon footprint was computed without the system frame and shipping crate. The estimated carbon footprint of the system frame and shipping crate are included in the carbon footprint report for the IBM z16™ multi frame CPC drawer.

1 Orchard Road
Armonk, NY 10504

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