ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 for

FJ4 Fan Coil Indoor Unit & 38MURA Heat Pump Outdoor Unit
Carrier Corporation

Program: The International EPD® System, www.environdec.com
Program operator: EPD International AB; this EPD is registered through aligned regional hub: EPD North America (www.epdna.com)
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Program Operator:	The International EPD® System
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Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2021:02 AIR-CONDITIONING MACHINES, version 1.0.1
Scope of the EPD®: North America & Global
PCR review was conducted by: The Technical Committee of the International EPD® System Chair of the PCR review: Paola Borla. Contacted via info@environdec.com
Life Cycle Assessment (LCA)
LCA accountability: Goutham Patil, HCLTech
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: Sunil Kumar, C S, Chakra4 Sustainability Consulting Services Approved by: The International EPD® System
The procedure for follow-up of data during EPD validity involves a third-party verifier: ☐ Yes ☒ No [Procedure for follow-up of the validity of the EPD is, at the minimum, required once a year to confirm whether the information in the EPD remains valid or if the EPD needs to be updated during its validity period. The follow-up can be organized entirely by the EPD owner or together with the original verifier via an agreement between the two parties. In both approaches, the EPD owner is responsible for the procedure. If a change that requires an update is identified, the EPD shall be re-verified by a verifier]

The EPD owner is the sole owner, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programs or not compliant with EN 15804 may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g., identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

GENERAL INFORMATION

Description of Company

Carrier is the leading global provider of healthy, safe, and sustainable building and cold chain solutions with a world-class, diverse workforce. Through performance-driven culture, shareholder value is driven by growing earnings and investing strategically to strengthen its position in the market. Carrier's industry leading solutions and services are designed to reduce energy consumption and facility operating costs in HVAC & Refrigeration.

Product Description

The Carrier HVAC self-contained air conditioner regulates indoor air quality in buildings using indoor and outdoor units. The comfort series FJ4 fan coil unit features Carrier technology, including grooved tubing, louvered fins, and updated coil circuitry, which enhance its performance. It includes solid-state fan controls, insulation, multi-speed motors, and wettable coils. This unit supports heaters ranging from 3 to 30 kW. Equipped with ECM motors, it delivers reliable air and increases static pressure. The Carrier 38MURA performance series horizontal outdoor unit provides a sleek and efficient air conditioning solution for both residential and commercial spaces. Its advanced technology ensures optimal comfort and energy efficiency. With a compact design, it fits seamlessly into various environments while delivering powerful cooling performance. The unit offers adjustable airflow and operates quietly, maintaining a comfortable indoor environment without disruptive noise. Its user-friendly controls and intuitive interface make operating and customizing settings straightforward. Additionally, the 38MURA outdoor unit delivers reliable performance and durable construction, ensuring long-lasting comfort and peace of mind for users.

Representative Product

Sl No.	Product Models	Tonnage	Unit	Weight in Kg
1	**FJ4DNXB3600EAAA**	**3**	**Indoor Unit**	**73.30**
2	**38MURAQ36AA3**	**3**	**Outdoor Unit**	**68.39**

The FJ4 Fan Coil & 38MURA Heat Pump units have tonnage range from 1.5 ton to 5 ton for both Indoor & Outdoor unit. The FJ4 3-ton Fan Coil Indoor Unit **FJ4DNXB3600EAAA** and its corresponding 3-ton Heat Pump Outdoor Unit **38MURAQ36AA3** have been selected as the representative products for Life Cycle Assessment (LCA) Modeling and Environmental Product Declaration (EPD) reporting due to their significant production volume and sales. Therefore, the LCA analysis is conducted based on this configuration.

Technical Information

Technical Information	Value	Unit
Cooling load P-design$_c$	36.70	kBtu/hr
Seasonal Energy Efficiency Ratio (SEER)	9.58	kBtu/hr/kW
Cooling - Power Input	3.83	kW
Heating load P-design$_h$	35.23	kBtu/h
Heating Seasonal Performance Factor (HSPF)	10.00	kBTU/hr/kW
Seasonal Coefficient of Performance (SCOP)	3.52	kW/kW
Heating Power Input	3.52	kW
Yearly operation hours in cooling	1535	hr
Yearly operation hours in heating	620.4	hr

UN CPC Code: 43912

Geographical Scope: North America & Global.

LCA Information

Functional Unit: The 1 kWh of thermal energy exchanged with the building in cooling and heating mode by a heating/cooling equipment using small-scale HVAC as defined in CPC 43912 and HS 8415 according to the appropriate usage scenario defined in the EN 14511 and EN14825 standards.

Reference Service Life: The reference service life for air conditioners is considered to be 20 years.

Time Representativeness: Data for the Financial Year 2023 was used in the study

Manufacturing Site Address: Carrier Mexico - (Carretera a Garcia Km 1.3 Parque Stiva Santa Catarina N.L., 66367 Santa Catarina, Nuevo Leon)

Database(s) and LCA Software Used: Background data is from Eco invent 3.10, LCA software used is One Click LCA

JRC characterization factors: The JRC characterization factors used in this study refer to PCR 2019:14 and EN 15804+A2 (based on EF 3.1)

System Boundaries: Cradle to Grave

LCA Scope

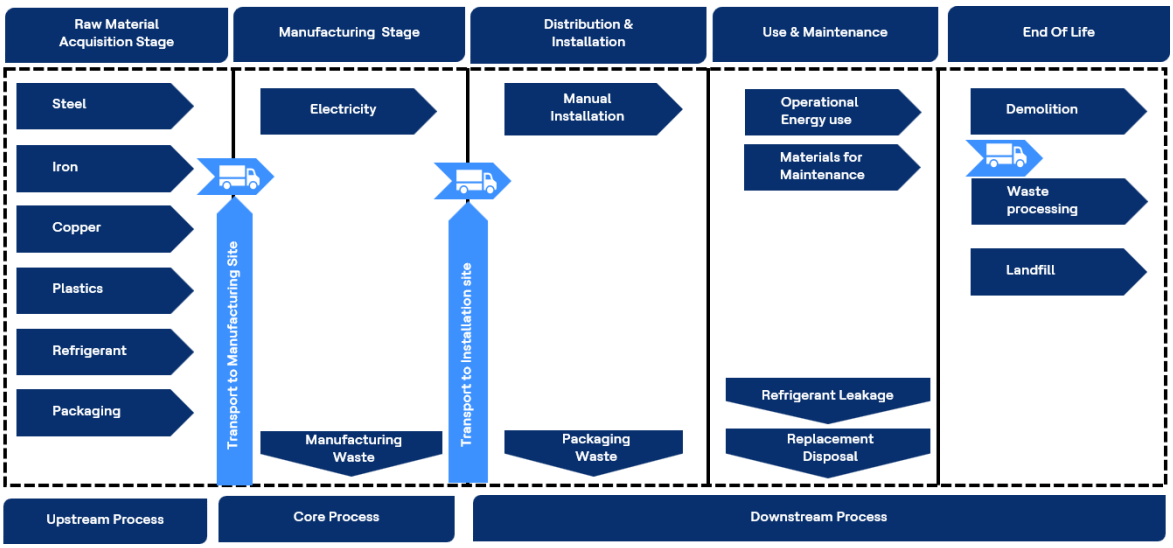
Process	Upstream & Core Process			Downstream Process												
Stage	Manufacturing Stage			Distribution & Installation stage		Use stage							End-of-life stage			
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Process	Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction	Transport	Waste processing	Disposal
Geography	US & GLO	GLO	MX & CN	GLO	GLO	GLO	GLO	-	-	-	US	-	GLO	GLO	GLO	GLO
Module	X	X	X	X	X	X	X	MND	MND	MND	X	MND	X	X	X	X

Acronym: US - United States, MX - Mexico, CN - China and GLO - Globe

Allocation: Mass allocation has been used wherever necessary.

Cut-off Rules: Material inputs greater than 1% (based on the total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data were available to warrant inclusion, and the material input was thought to have a significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on the total weight of the declared unit.

System Boundary diagram



Description of Each Process

Raw Material Acquisition & Manufacturing Stage

The product's life cycle commences with the extraction and refining of raw materials such as metals, non-metals, plastics, and packaging. These materials are then processed into components through methods such as molding or machining and subsequently assembled into the final product using techniques such as welding, soldering, or adhesion. Packaging materials are employed for the protection and transportation of the product. The logistical planning for transporting raw materials to the manufacturing facility is based on supplier location data provided by Carrier. Energy consumption during manufacturing, particularly during assembly and joining processes, is calculated using plant-level energy bills supplied by Carrier.

Distribution Stage

The product is delivered to international customers by container ship covering 10,000 kilometers and for local customers or end-users, the product is delivered by truck, covering 1,000 kilometers as per PCR assumptions. It's important to note that this analysis does not consider factors that might affect fuel consumption during the return trip.

Installation Stage

The installation procedure is assumed to be manual and requires no operational energy. It is assumed that no product loss occurred during installation. Packaging materials are considered to be disposed of in a landfill, and this disposal process, including transportation to the disposal site, is factored into the installation process.

Use Stage

Over a 20-year reference service life, the usage involves electricity consumption and potential refrigerant R-410A leakage. Regular maintenance, including refrigerant recharges, is necessary to ensure efficient and safe operation of the product. The impacts associated with Repair (B3), Replacement (B4), Refurbishment (B5) and Operational water use (B7) stages, are negligible, accounting for less than 1% of total input in the use stage. These stages are excluded from this study as optional modules, as they fall below the cut-off criteria per the PCR guidelines. Therefore, these life cycle modules are not declared (MND) and are not included in this LCA.

End of Life

At its end of life, the product will be transported by truck to a recycling facility for dismantling and disposal. Metal components will be recycled, while plastic components will be sent to a landfill. It is assumed that 90% of refrigerant will be recovered and 10% will be released to the atmosphere during disassembly.

Content Declaration: No substances are required to be reported as hazardous according to the US Resources Conservation and Recovery Act, Subtitle 3, associated with the production of this product.

Material Composition: The raw materials for the product were obtained from suppliers in the United States, China, and Mexico. The general compositions of the products are represented below.

Class/Materials	Indoor Unit in [kg]	Outdoor Unit in [kg]	Total weight in [kg]	Total Weight in [%]
Steel	47.30	40.19	87.50	61.74%
Aluminum	8.55	5.58	14.14	9.98%
Iron	0	4.77	4.77	3.37%
Copper	0.56	8.36	8.92	6.29%
Stainless Steel	0.09	0	0.09	0.06%
Brass	0.57	0	0.57	0.40%
Plastics	3.40	2.42	5.84	4.12%
Non-Metallics	0.64	0.23	0.87	0.61%
Refrigerant R-410A	3.70		3.70	2.61%
Electronics	0.82	2.57	3.39	2.39%
Corrugated Cardboard	3.99	3.41	7.40	5.22%
Wood	3.52	0	3.52	2.48%
Paper	0.16	0	0.16	0.12%
EPS	0	0.82	0.82	0.57%
PP tape	0	0.02	0.02	0.02%
PE Packing Bag	0	0.02	0.02	0.02%

Life Cycle Assessment Results

The FJ4 fan coil indoor units and 38MURA outdoor heat pump units share consistent raw materials, manufacturing processes, and functions. Additionally, their assembly procedures are similar. As a representative product type for displaying life cycle assessment (LCA) results, we've chosen the 3 ton FJ4 Fan Coil indoor unit paired with the 3 ton 38MURA Heat Pump outdoor unit. All the results refer to 1 kWh of thermal energy exchanged with the building in cooling and heating mode by a heating/cooling equipment of 3 ton FJ4 fan coil indoor unit and 3 ton 38MURA heat pump outdoor unit.

Below tables shows the result per FU (Connection between functional unit and reference flow: divided by 10.63 kWh).

CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
GWP – total	kg CO2 eq/kWh	9.83E+01	2.63E+00	6.11E+03	6.21E+03
GWP – fossil	kg CO2 eq/kWh	9.79E+01	5.08E+00	6.10E+03	6.20E+03
GWP – biogenic	kg CO2 eq/kWh	0.00E+00	-2.48E+00	2.48E+00	0.00E+00
GWP – LULUC	kg CO2 eq/kWh	3.77E-01	2.50E-02	6.72E-01	1.07E+00
Ozone depletion pot.	kg CFC-11 eq/kWh	1.68E-04	7.06E-08	1.07E-04	2.76E-04
Acidification potential	mol H+ eq/kWh	9.48E-01	4.51E-02	1.65E+01	1.75E+01
EP-freshwater	kg P eq/kWh	1.04E-02	1.31E-04	5.37E-01	5.48E-01
EP-marine	kg N eq/kWh	1.33E-01	1.23E-02	3.03E+00	3.17E+00
EP-terrestrial	mol N eq/kWh	1.67E+00	1.26E-01	3.48E+01	3.66E+01
POCP ("smog")	kg NMVOC eq/kWh	5.20E-01	3.86E-02	1.27E+01	1.33E+01
ADP-minerals & metals	kg Sb eq/kWh	9.97E-03	9.84E-06	6.30E-02	7.30E-02
ADP-fossil resources	MJ/kWh	1.12E+03	7.10E+01	8.92E+04	9.04E+04
Water deprivation potential	m^3eq /kWh	4.04E+01	9.74E-01	1.93E+03	1.97E+03

Acronym
GWP = Global Warming Potential; LULUC= Land Use & Land Use Change; EP = Eutrophication Potential; POCP = Photochemical ozone formation; ADP = Abiotic Depletion Potential

***Disclaimer**: The results of this environmental impact indicator shall be used with care as the uncertainties of the results are high and as there is limited experience with the indicator.*

ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
Particulate matter	Incidence/kWh	7.98E-06	3.72E-07	1.03E-04	1.11E-04
Ionizing radiation	kBq U235e/kWh	2.05E+00	7.22E-02	4.31E+02	4.33E+02
Ecotoxicity (freshwater)	CTUe/kWh	2.64E+03	1.89E+01	2.13E+04	2.40E+04
Human toxicity, cancer	CTUh/kWh	2.31E-06	2.14E-08	1.08E-05	1.31E-05
Human tox. non-cancer	CTUh/kWh	3.23E-06	3.83E-08	7.84E-05	8.17E-05
SQP	-/kWh	4.82E+02	2.65E+02	2.26E+04	2.33E+04

Acronym
SQP = Land use-related impacts/soil quality.

USE OF NATURAL RESOURCES

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
Renew. PER as energy	MJ/kWh	1.70E+02	1.47E+01	3.64E+04	3.66E+04
Renew. PER as material	MJ/kWh	0.00E+00	2.18E+01	-2.18E+01	0.00E+00
Total use of renew. PER	MJ/kWh	1.70E+02	3.66E+01	3.64E+04	3.66E+04
Non-re. PER as energy	MJ/kWh	1.11E+03	6.70E+01	8.92E+04	9.04E+04
Non-re. PER as material	MJ/kWh	0.00E+00	4.12E+00	-4.12E+00	0.00E+00
Total use of non-re. PER	MJ/kWh	1.11E+03	7.11E+01	8.92E+04	9.04E+04
Secondary materials	Kg/kWh	3.33E+00	5.80E-01	1.83E+01	2.22E+01
Renew. secondary fuels	MJ/kWh	2.80E-02	4.12E-01	1.25E-01	5.65E-01
Non-ren. secondary fuels	MJ/kWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m^3/kWh	9.48E-01	2.28E-02	5.40E+01	5.50E+01

Acronym
PER = Primary energy resource

END OF LIFE – WASTE

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
Hazardous waste	kg/kWh	2.32E+01	2.43E-01	3.10E+02	3.34E+02
Non-hazardous waste	kg/kWh	3.25E+02	3.72E+00	2.52E+04	2.55E+04
Radioactive waste	kg/kWh	1.72E-03	4.74E-05	2.43E-01	2.45E-01

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
Components for re-use	Kg/kWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	Kg/kWh	0.00E+00	0.00E+00	1.05E+01	1.05E+01
Materials for energy recovery	Kg/kWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ/kWh	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
Global Warming Pot.	kg CO2 eq/kWh	9.82E+01	5.16E+00	6.08E+03	6.18E+03
Ozone depletion Pot	kg CFC-11 eq/kWh	2.06E-04	6.44E-08	1.17E-04	3.23E-04
Acidification	kg SO2 eq/kWh	7.79E-01	3.54E-02	1.35E+01	1.44E+01
Eutrophication	kg PO43 eq/kWh	1.38E-01	1.53E-02	3.20E+00	3.35E+00
POCP (“smog”)	kg C2H4 eq/kWh	7.42E-02	2.27E-03	8.46E-01	9.23E-01
ADP-elements	kg Sb eq/kWh	9.97E-03	9.60E-06	6.28E-02	7.28E-02
ADP-fossil	MJ/kWh	1.12E+03	7.09E+01	8.92E+04	9.04E+04

ENVIRONMENTAL IMPACTS – TRACI 2.1. / ISO 21930

Impact category	Unit	Upstream Process	Core Process	Downstream Process	Total
Global Warming Pot.	kg CO2 eq/kWh	9.73E+01	5.10E+00	6.05E+03	6.15E+03
Ozone depletion Pot	kg CFC-11 eq/kWh	2.08E-04	8.06E-08	1.26E-04	3.34E-04
Acidification	kg SO2 eq/kWh	7.71E-01	3.87E-02	1.40E+01	1.49E+01
Eutrophication	kg PO43 eq/kWh	1.27E-01	8.29E-03	4.50E+00	4.64E+00
POCP ("smog")	kg C2H4 eq/kWh	8.41E+00	7.37E-01	2.04E+02	2.13E+02
ADP-fossil	MJ/kWh	1.09E+03	6.70E+01	8.92E+04	9.03E+04

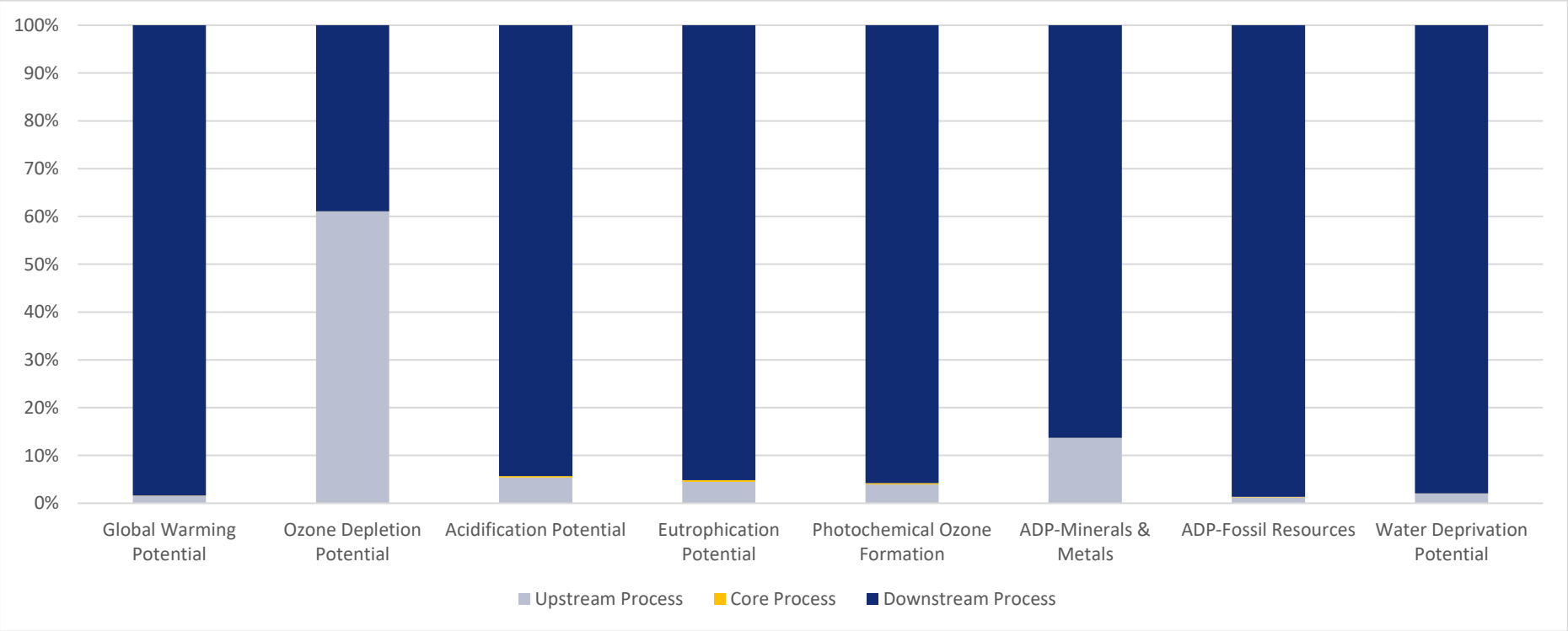
SUPPLEMENTAL B6 RESULTS

The results provided in the section above are representative of the North America scope of the EPD. However, the B6 module has a large impact on the total results. Extended results are provided for all mandatory environmental impact categories in the table below. The extended results represent switching the operational electricity used in module B6 to Europe, China & Global. The rest of the modules have identical results and are excluded from this table.

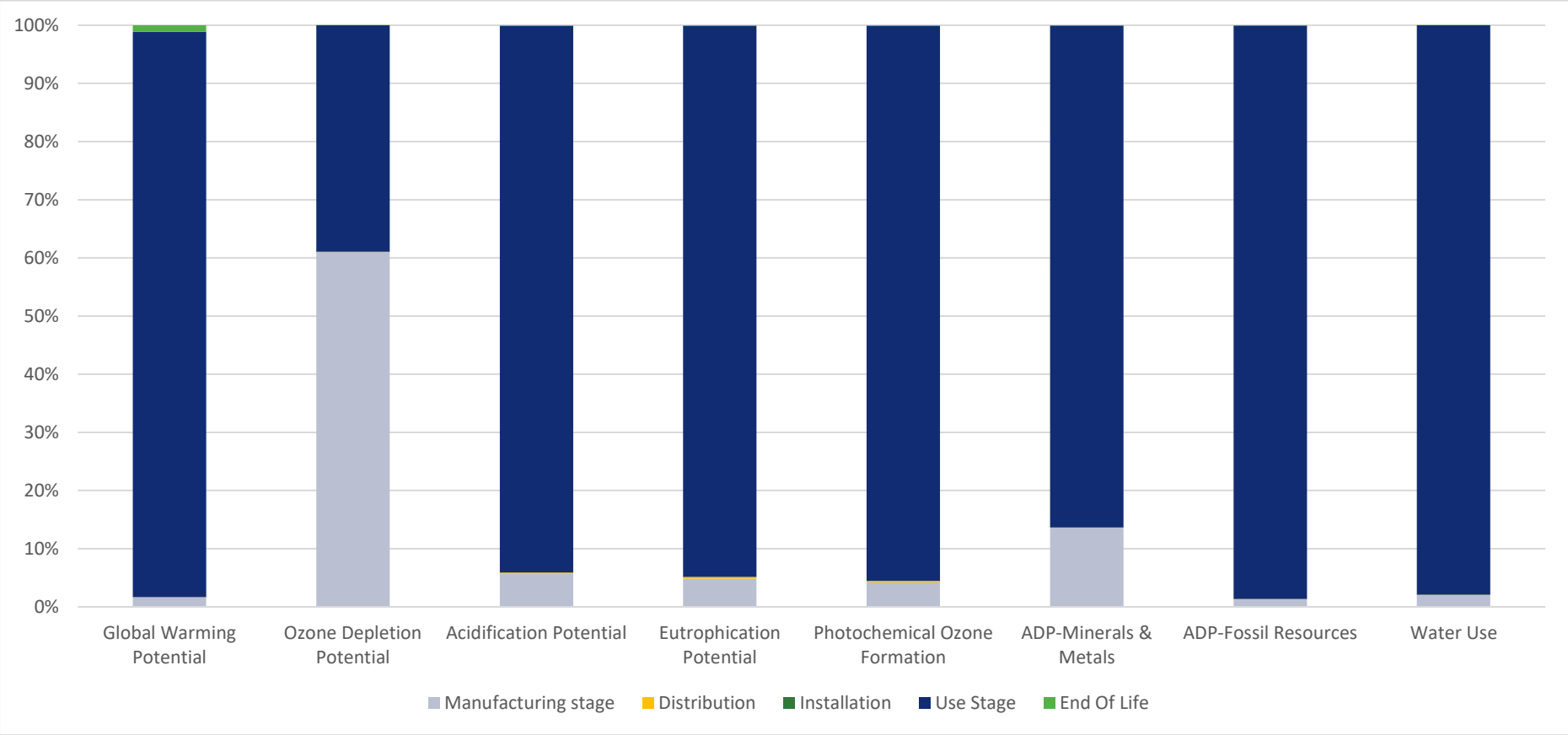
Impact category	Unit	Operational Energy Use [B6]		
		Europe	China	Global
GWP – total	kg CO_2 eq/kWh	5.84E+03	1.67E+04	1.11E+04
GWP – fossil	kg CO_2 eq/kWh	5.82E+03	1.67E+04	1.11E+04
GWP – biogenic	kg CO_2 eq/kWh	0.00E+00	0.00E+00	0.00E+00
GWP – LULUC	kg CO_2 eq/kWh	1.44E+01	2.12E+00	2.32E+01
Ozone depletion pot.	kg CFC-11 eq/kWh	3.03E-04	8.70E-05	3.73E-04
Acidification potential	mol H^+ eq/kWh	3.20E+01	8.81E+01	5.63E+01
EP-freshwater	kg P eq/kWh	6.48E-01	3.56E-01	5.81E-01
EP-marine	kg N eq/kWh	4.16E+00	1.80E+01	9.50E+00
EP-terrestrial	mol N eq/kWh	4.75E+01	1.98E+02	1.06E+02
POCP ("smog")	kg NMVOC eq/kWh	1.31E+01	5.15E+01	2.86E+01
ADP-minerals & metals	kg Sb eq/kWh	5.62E-02	5.05E-02	5.18E-02
ADP-fossil resources	MJ/kWh	1.23E+05	1.46E+05	1.44E+05
Water deprivation potential	m^3eq /kWh	3.58E+03	1.77E+03	3.03E+03

INTERPRETATION

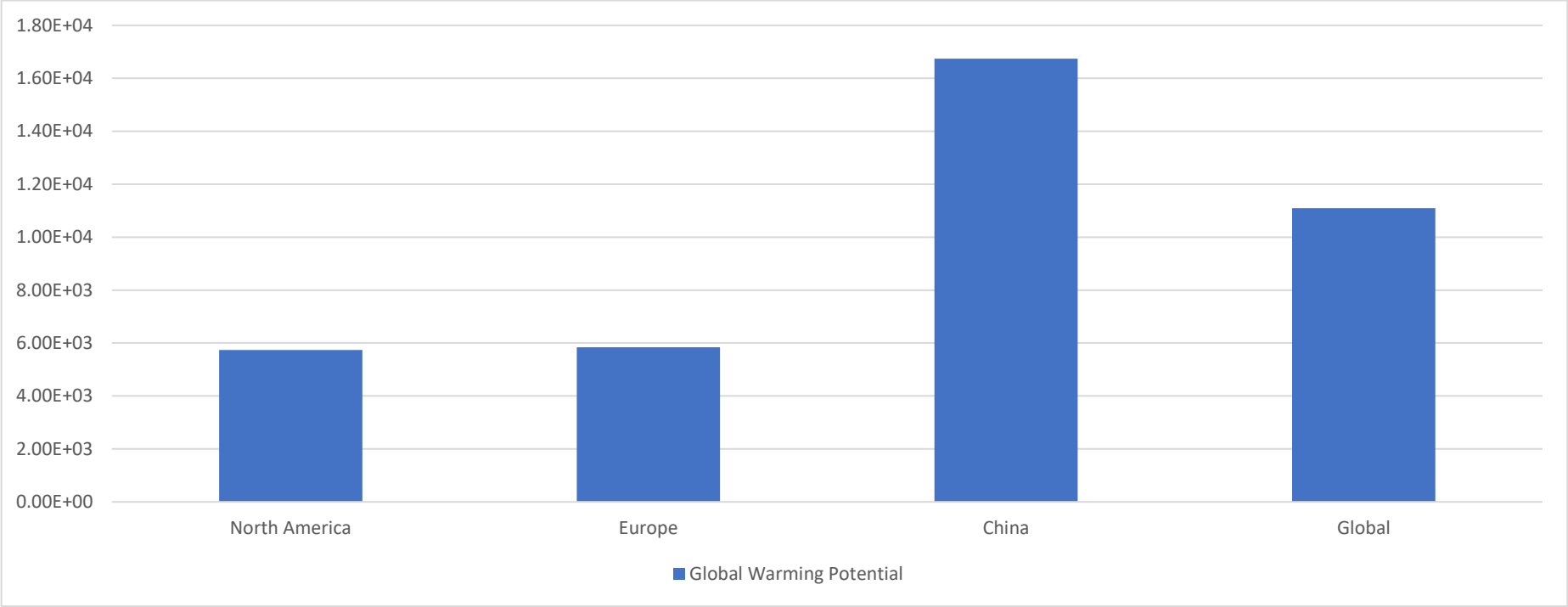
The below graph shows the contribution results of the environmental indicators of the representative product type [FJ4DNXB3600EAAA + 38MURAQ36AA3] to life cycle processes. The downstream processes have a greater contribution to the life cycle, followed by the upstream processes.



The graph below shows the analysis of the LCA stages. It clearly highlights that the Use Stage has the greatest environmental impact, followed by the Manufacturing Stage. The impacts from Distribution, Installation, and End-of-Life stages are relatively less in comparison.



The graph below illustrates the analysis of operational energy use (B6) and its Global Warming Potential (GWP) impacts across different regions. It shows that North America and Europe have lower Global Warming Potential (GWP) impacts compared to China and the Global region.



Abbreviations

AC: Air Conditioner
CO2: Carbon dioxide
CPC: Central product classification
EN: European standard
EPD: Environmental product declaration
ISO: International Organization for Standardization
kg: kilogram
kWh: Kilowatt hour
LCA: Life cycle assessment
PCR: Product Category Rules
$Pdesign_c$: Rated cooling capacity according to EN 14825
$Pdesign_h$: Rated heating capacity according to EN 14825
RLT: Reference Lifetime
SCOP: Seasonal performance coefficient
SEER: Seasonal cooling capacity
Ton: Tonnage

References

1. General Programme Instructions of the International EPD® System. Version 5.0.
2. PCR, 2021:02 AIR-CONDITIONING MACHINES PRODUCT, version 1.0.1
3. ISO 14020:2000: Environmental labels and declarations – General principles
4. ISO 14040:2006: Environmental Management – Life Cycle Assessment - Principles and Framework
5. ISO 14044:2006, Environmental management - Life cycle assessment - Principles and guidelines
6. EN 15804:2012+A2:2019, Sustainability of construction works Environmental product declarations Core rules for the product category of construction products
7. BS EN 50693:2019, Product category rules for life cycle assessments of electronic and electrical products and systems

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