BUSINESS JETS

PRODUCT CATEGORY CLASSIFICATION: UN CPC 49623

PCR 2018:09
VERSION 1.0.4

VALID UNTIL: 2023-11-23

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1 INTRODUCTION

This document constitutes Product Category Rules (PCR) developed in the framework of the International EPD® System: a programme for type III environmental declarations[1] according to ISO 14025:2006. Environmental Product Declarations (EPD) are voluntary documents for a company or organisation to present transparent information about the life cycle environmental impact for their goods or services.

The rules for the overall administration and operation of the programme are the General Programme Instructions, publicly available at www.environdec.com. A PCR complements the General Programme Instructions and the standards by providing specific rules, requirements and guidelines for developing an EPD for one or more specific product categories (see Figure 1). A PCR should enable different practitioners using the PCR to generate consistent results when assessing products of the same product category.

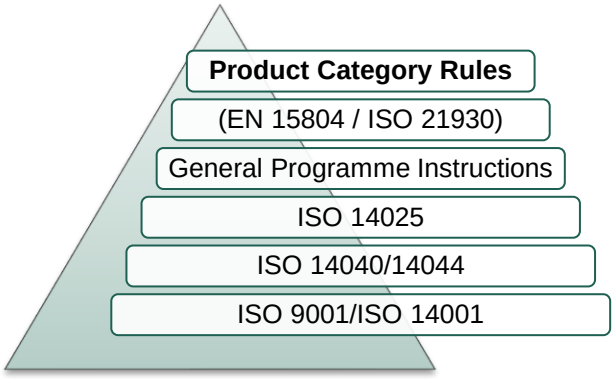

Figure 1 Illustration PCR in relation to the hierarchy of standards and other documents.

Within the present PCR, the following terminology is adopted:

- The term “shall” is used to indicate what is obligatory.
- The term “should” is used to indicate a recommendation, rather than a requirement.
- The term “may” or “can” is used to indicate an option that is permissible

For the definition of terms used in the document, see the normative standards.

A PCR is valid for a pre-determined period of time to ensure that it is updated at regular intervals. The latest version of the PCR is available via www.environdec.com. Stakeholder feedback on PCRs is very much encouraged. Any comments on this PCR document may be given via the PCR Forum at www.environdec.com or sent directly to the PCR moderator during its development or during the period of validity.

Any references to this document should include the PCR registration number, name and version.

The programme operator maintains the copyright of the document to ensure that it is possible to publish, update when necessary, and available to all organisations to develop and register EPDs. Stakeholders participating in PCR development should be acknowledged in the final document and on the website.

[1] Type III environmental declarations in the International EPD® System are referred to as EPD, Environmental Product Declarations.

2 GENERAL INFORMATION

2.1 ADMINISTRATIVE INFORMATION

Name:	Business jets
Registration number and version:	2018:09, version 1.0.4
Programme:	The International EPD® System
Programme operator:	EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. Website: www.environdec.com E-mail: info@environdec.com
PCR moderator:	Miguel Fernando García Claro, Bombardier, miguel.garcia.claro@aero.bombardier.com
PCR Committee:	▪ ASPIRE SUSTAINABILITY LLC **Angela FISHER** Co-founder & Director angela@aspiresustainability.com ▪ CARBON WAR ROOM - ROCKY MOUNTAIN INSTITUTE **Adam KLAUBER** Director of Sustainable Aviation aklauber@carbonwarroom.com ▪ GE AVIATION - GENERAL ELECTRIC COMPANY **Jieun KIRTLEY** Lead Branding Strategy Specialist jieun.Kirtley@ge.com ▪ CIRAIG – CORPORATION DE L'ÉCOLE POLYTECHNIQUE DE MONTRÉAL **Jean-François MENARD** Senior Analyst jean-francois.menard@polymtl.ca
Date of publication and last revision:	2023-05-16 (Version 1.0.4). Version 1.0 was published 2018-11-23.
Valid until:	2023-11-23
Schedule for renewal:	A PCR is valid for a pre-determined period of time to ensure that it is updated at regular intervals. When the PCR is about to expire the PCR moderator shall initiate a discussion with the Secretariat how to proceed with updating the document and renewing its validity. A PCR document may be revised during its period of validity provided significant and well-justified proposals for changes or amendments are presented. See www.environdec.com for up-to-date information and the latest version.

Standards conformance:	General Programme Instructions of the International EPD® System, version 3.0 [1], based on ISO 14025 [2] and ISO 14040 [3]/14044 [4] PCR Basic Module, CPC Division 49 Transport equipment, version 3.0, dated 2018-05-03 [5]
PCR language(s):	This PCR was developed and is available in English. In case of translated versions the English version takes precedence in case of any discrepancies.

2.2 SCOPE OF PCR

2.2.1 PRODUCT CATEGORY DEFINITION AND DESCRIPTION

This document provides Product Category Rules (PCR) for the assessment of the environmental performance of ***Business jets*** and the declaration of this performance by an EPD. The product category corresponds to UN CPC 49623: *"Aeroplanes and other powered aircraft of an unladen weight exceeding 2000 kg" (Table 1).*

Table 1 UN CPC Classification Hierarchy

United Nations Central Product Classification		***UN CPC 49623***
Section:	*4 -*	*Metal products, machinery and equipment*
Division:	*49 -*	*Transport equipment*
Group:	*496 -*	*Aircraft and spacecraft, and parts thereof*
Class:	*4962 -*	*Aeroplanes and helicopters*
Subclass:	*49623 -*	*Aeroplanes and other powered aircraft of an unladen weight exceeding 2000 kg*

For additional information, please refer to https://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=25&Lg=1&Co=49623

However, this category applies to products which have different functions and which cannot be covered within one only PCR.

This PCR will only focus on ***Business jets propelled by jet engines*** *and not by turboprops nor pistons powered engines. Equally, this PCR neither focus on business-converted airliners nor missionized configurations like:*

Transportation of cargo, parts and mail	*Agricultural applications*	*Airborne research and development*
Medical and emergency transport	*Game tracking and control*	*Pipeline and utility monitoring*
Mapping and surveying	*Security and law enforcement*	*Weather monitoring and reporting*
Aerial photography	*Newsgathering*	*Humanitarian missions*

2.2.2 SPECIFICATION OF THE PRODUCT

Different categories of Business jets can be distinguished [6] [7] [8] *based upon some relevant specifications: cabin volume and flight range, described in the Table 2. These specifications shall be used to define and declare the Business jet category in the EPD.*

Table 2 Specifications of the Business Jets

Categories	***Cabin volume (m3)***	***Flight range (km)***
Light	*8.5 – 19.8 (300 ft^3 – 700 ft^3)*	*3 704 – 5 741.2 (2 000 nm – 3 100 nm)*
Medium	*19.8 – 42.5 (700 ft^3 – 1 500 ft^3)*	*5 741.2 – 9260 (3 100 nm – 5 000 nm)*
Large	*42.5 – 85 (1 500 ft^3 – 3 000 ft^3)*	*> 9260 (> 5 000 nm)*

*This PCR is **ONLY** applicable to the purpose-built light, medium and large categories of Business jet* [8] *which shall be declared in the EPD.*

The EPD shall also define the main specifications of the Business jet declared as reported in Table 3.

Table 3: Business jet description

Information	***Explanations***
Commercial name	*n/a*
Type Certificate Data Sheet (TCDS) Number	*As per certification body database*
Date of certification	*As per TCDS*
Certification body	*FAA, EASA, Transport Canada, JAA, national authorities...*
Propulsion system	*Jet engines*
Engine trade name	*As per TCDS*
Standard accommodation	*Baseline configuration*
Maximum seating capacity	*As per TCDS*
Maximum takeoff weight	*In kg, as per TCDS*
Takeoff field length	*At ISA, sea level and Maximum takeoff weight*
Maximum Cruising speed	*In km/h and Mach*
Maximum operating altitude	*In m and ft, as per TCDS*
Maximum range @ Standard accommodation	*In km*

The product category shall be declared in the EPD (Business Jets).

2.2.3 GEOGRAPHICAL REGION

Business jets are products used worldwide. This is a global market thus; the scope of this PCR is also set to be Global.

2.2.4 EPD VALIDITY

An EPD based on this PCR shall be valid from its registration and publication at www.environdec.com and for a five year period starting from the date of the verification report (“approval date”), or until the EPD has been de-registered from the International EPD® System.

An EPD shall be updated and re-verified during its validity if changes in technology or other circumstances have led to:

- an increase of 10% or more of any of the indicators listed in Section 5.4.5.1,
- errors in the declared information, or
- significant changes to the declared product information, content declaration, or additional environmental information.

If such changes have occurred, but the EPD is not updated, the EPD owner shall contact the Secretariat to de-register the EPD.

3 PCR REVIEW AND BACKGROUND INFORMATION

This PCR was developed in accordance with the process described in the General Programme Instructions of the International EPD® System [1], including PCR review and open consultation.

3.1 PCR REVIEW

3.1.1 VERSION 1.0

PCR review panel:	The Technical Committee of the International EPD® System. A full list of members available on www.environdec.com. The review panel may be contacted via info@environdec.com. Members of the Technical Committee were requested to state any potential conflict of interest with the PCR moderator or PCR committee, and were excused from the review.
Chair of the PCR review:	Adriana Del Borghi
Review dates:	2018-09-28 until 2018-11-14

3.2 OPEN CONSULTATION

3.2.1 VERSION 1.0

This PCR was available for open consultation from *2018-06-12* until *2018-08-07*, during which any stakeholder was able to provide comments by posting on the PCR forum on www.environdec.com or by contacting the PCR moderator.

Stakeholders were invited via e-mail or other means to take part in the open consultation, and were encouraged to forward the invitation to other relevant stakeholders. The following stakeholders provided comments during the open consultation, and agreed to be listed as contributors to the PCR and at www.environdec.com:

- *Asociación Española de Technologías de Defensa, Aeronáutica y Espacio (TEDAE)*

3.3 EXISTING PCRS FOR THE PRODUCT CATEGORY

As part of the development of this PCR, existing PCRs were considered in order to avoid overlaps in scope. The existence of such documents was checked in the public PCR listings of the following programmes based on ISO 14025 or similar:

- *ASTM International EPD Program - USA*
- *Canadian Standards Association – Canada*
- *Carbon Footprint Label – Korea*
- *Carbon Footprint of Products – Japan*
- *Carbon Leadership Forum PCRs – USA*
- *Chinese EPD program – China*
- *Earth Sure – USA*
- *Eco-Leaf – Japan*
- *Environmental Declaration of Products (EDP) – Korea*

- *EPD Denmark – Danemark*
- *EPD-Norway- Norway*
- *GlobalEPD – Spain*
- *International EPD® System. www.environdec.com.*
- *NSF International National Center for Sustainability Standards EPD – USA*
- *PAS 2050 – UK*
- *Product Life Cycle Accounting and Reporting Standard – USA*
- *SCS Global Services – USA*
- *SM Transparency Report Program – USA*
- *Taiwan EPA Carbon Label – Taiwan*
- *UL Environment EPD – USA*

No existing PCRs with overlapping scope were identified.

3.4 REASONING FOR DEVELOPMENT OF PCR

This PCR was developed in order to enable publication of Environmental Product Declarations (EPD) for this product category based on ISO 14025 [2], ISO 14040 [3]/14044 [4] and other relevant standards to be used in different applications and target audiences.

Passenger commercial aircraft's PCR (PCR 2015:02 CPC code 49623) was developed for the first time in 2015 paving the way for introduction of the first EPD in the aviation industry. The PCR 2015:02 does not cover the Business Jet's functional unit described in Section 4.1. Therefore, it is essential to develop an exclusive PCR for this sector as an important part of the general aviation market.

3.5 UNDERLYING STUDIES

The methodological choices made during the development of this PCR (functional unit/declared unit, system boundary, allocation methods, impact categories, data quality rules, etc.) in this PCR were primarily based on the following underlying studies:

- *PCRs used to support methodological choices and as references during the development: Passenger Commercial Aeroplanes - UN CPC 49623* [9]
- *Emission methodology considerations for Business Jet: International Civil Aviation Organization (ICAO), Annex 16 to the convention of international civil aviation, Environmental Protection, Volume II – Aircraft Engine Emissions* [10]
- *Noise methodology evaluation for Business Jet: International Civil Aviation Organization (ICAO), Annex 16 to the convention of international civil aviation, Environmental Protection, Volume I – Aircraft Noise* [11]
- *Doc 9501, Environmental Technical Manual: International Civil Aviation Organization (ICAO), Volume I, Procedures for the Noise Certification of Aircraft* [12]
- *Recyclability and recoverability Calculation method used to develop Business Jet's End-of-Life calculations: ISO 22628, Road vehicles-Recyclability and recoverability-Calculation method, 2002* [13]
- *Best Management Practice (BMP) for Management of Used Aircraft Parts and Assemblies and for Recycling of Aircraft Materials: Aircraft Fleet Recycling Association (AFRA), 2017* [14]

4 GOAL AND SCOPE, LIFE CYCLE INVENTORY AND LIFE CYCLE IMPACT ASSESSMENT

The goal of this section is to provide specific rules, requirements and guidelines for developing an EPD for the product category as defined in Section 2.2.1.

4.1 FUNCTIONAL UNIT/DECLARED UNIT

The functional unit for the different types of Business jet shall be used to scale the considered inputs, outputs and environmental impacts of the studied product system.

*The main function of a **Business jet** is the transport of a given volume of accommodation space for leisure or business purposes over a distance.*

The total accommodation volume shall include all pressurized areas accessible to both crew and passengers at all cruise altitudes and without any limitations, with the following boundaries:

- *Forward and aft boundaries shall be respectively the cockpit divider and the rear pressure bulkhead*
- *Cabin peripheral boundary shall be the cabin unfinished cross-section, limited to the furnishable area*

The unfinished cross-section furnishable area is the cross sectional area inside the frames and above the floor, as illustrated in Figure 2*.*

*The functional unit chosen to quantify the main function is **transport one cubic meter of accommodation space for leisure or business purposes over 100 km for a given typical mission length** (Appendix A: Mission selection in the PCR).*

The functional unit shall be stated in the EPD. The environmental impact shall be given per declared unit. A description of the function of the product should be included in the EPD®, if relevant.

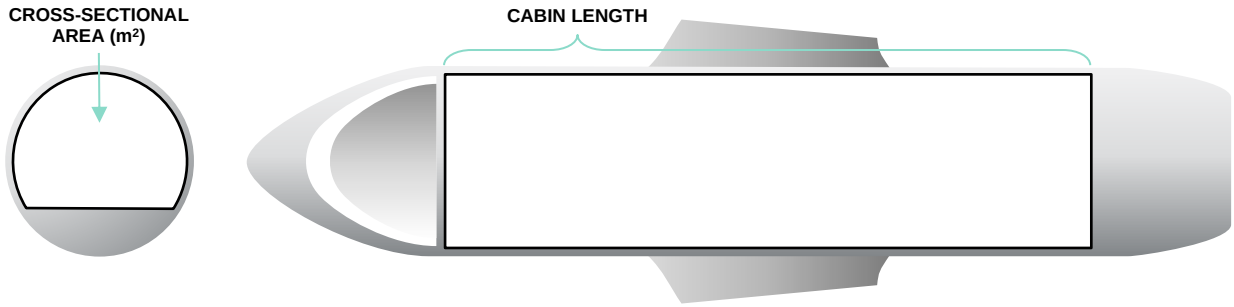

Figure 2: Example of the unfinished Business Jet Cross-sectional area and cabin length, from cockpit divider to the rear pressure bulkhead

4.1.1 CONFIGURATION RULES

For the same Business jet, different configurations can be considered. That is why the following parameters shall be declared in the EPD for the selected configuration:

- *Complete layout of passenger accommodation space and number of passenger seats*
- *Cabin volume, unfinished cross-sectional area and cabin length with given layout, from cockpit divider to the rear pressure bulkhead*
- *Pressurized baggage volume with given layout*
- *Standard items and weights (see glossary).*

- *Operational items and weight (see glossary).*

Additionally, in order to enable a fair environmental comparison, OEM shall declare the number of passengers, crews and flight attendants used for the fuel calculations respecting the loading envelope as recommended by FAA [15]*:*

- *A weight of 102.1 kg (225 lb) shall be considered per passenger as mentioned in FAA Circular 120-27E for winter[2] case scenario including:*
  - *Standard average adult passenger's weight: 81.2 kg (179 lb)*
  - *Standard average personal items and carry-on bag's weight: 7.3 kg (16 lb)*
  - *Standard average baggage's weight:13.6 kg (30 lb);*
- *A weight of 108.9 kg (240 lbs) shall be considered per flight crewmember including baggage;*
- *A weight of 95.3 kg (210 lbs) shall be considered per flight attendant including baggage;*

All other information regarding configuration may be put in the EPD if found relevant.

4.1.2 RANGE

The range (defined in the glossary) is one of the main drivers of the environmental impact. That is why the following average ranges[3] are defined and shall be used for the LCA calculation (See Appendix A: Mission selection in the PCR *for details on why this range has been selected):*

- *926.00 km (500 nm) shall be considered for Light Business Jet*
- *1482.00 km (800 nm) shall be considered for Medium Business Jet*
- *2408.00 km (1300 nm) shall be considered for Large Business Jet*

These ranges are ONLY applicable for the Light, Medium and Large categories of Business jets.

The results shall then be scaled to the functional unit of 100 km.

4.2 SYSTEM BOUNDARY

The International EPD® System uses an approach where all attributional processes from "cradle to grave" should be included using the principle of "limited loss of information at the final product". This is especially important in the case of business-to-consumer communication.

The scope of this PCR and EPDs based on it is *considered as cradle-to-grave.*

4.2.1 LIFE CYCLE STAGES

For the purpose of different data quality rules and for the presentation of results, the life cycle of the *Business jet* is divided into four different life cycle stages:

- Upstream
- Core

[2] *In order to represent the worst case scenario.*

[3] *Average ranges presented in SI unit are rounded to the nearest ten.*

- Operation *(corresponds to downstream process in the General Programme Instruction)*
- End-of-Life *(corresponds to downstream process in the General Programme Instruction)*

In the EPD, the environmental performance associated with each of the four life-cycle stages above shall be reported separately. The processes included and excluded in the scope of the PCR and belonging to each life cycle stage are described in Sections 4.2.1.1–4.2.1.4.

4.2.1.1. Upstream processes

The following upstream processes shall be included:

- *Extraction and production of raw and basic materials composing the Business jet: structure, power plant, systems and all fixed interior equipment.*
- *Energy production (electricity or fuel (see glossary for definition)) for the production/assembly of parts by tier-1 suppliers and/or original equipment manufacturer (excluding final assembly)*
- *Water consumption for the production/assembly of parts by tier-1 suppliers[4] and/or original equipment manufacturer[5] (excluding final assembly)*
- *Generation and treatment of waste (liquid and solid) for the production/assembly of parts by tier-1 suppliers and/or original equipment manufacturer (excluding final assembly).*
- *Transportation of Business jet shipsets from OEM manufacturing and/or sub-assembly facilities to Business jet final assembly plant.*
- *Transportation of Business jet shipsets from tier-1 suppliers manufacturing facilities to Business jet final assembly plant*

The following processes shall be excluded:

- *All infrastructure life cycle*
- *Production, maintenance, dismantling and disposal of vehicles used for transportation*
- *Transportation of raw and basic materials to suppliers' manufacturing plants.*
- *Production of packaging of parts/sub-assemblies/assemblies sent to final assembly line*
- *Energy and water consumption for the production/assembly of parts by sub-tier-1 suppliers shall be excluded except if a significant quantity of an assembly is outsourced. (see Cut-off rules 4.4)*
- *Generation and treatment of waste (liquid and solid) for the production/assembly of parts by sub-tier-1 suppliers shall be excluded except if a significant quantity of an assembly is outsourced. (see Cut-off rules 4.4)*

4.2.1.2. Core processes

The following core processes shall be included:

- *Production and use of electricity for final assembly of the aeroplane (e.g. electricity or fuel)*
- *Production and use of water consumed for final assembly of the aeroplane*
- *Generation and treatment of waste and wastewater from the final assembly processes*
- *All aircraft final assembly processes*
- *Pre-certification flight tests*

The following processes shall be excluded:

[4] *Tier-1 Suppliers are manufacturers who provide directly to the original company that assembles the end product*

[5] *Original Equipment Manufacturers (OEM) is a company who produces a part or a subsystem used in another company's end product*

- *All infrastructure life cycle (e.g. machinery, manufacturer facility…)*
- *Business travel of personnel*
- *Travel to and from work by personnel*
- *Research and development activities*
- *Transportation inside manufacturing plants*

4.2.1.3. Operation module

The following operation processes shall be included:

- *In-flight emissions of engines*
- *Emissions of Auxiliary Power Unit (APU).*

  When the Business jet does not have APU, then energy and/or fuel type and consumption on ground from: external power generator, tug, or pneumatics system shall be declared and used.
- *Production of spare parts for maintenance*
- *Extraction and production of paint used throughout the life of the aircraft*
- *Fuel production (Kerosene baseline) and transportation for the operation of the Business jet*
- *Transportation of maintenance materials and spare parts*

The following processes shall be excluded:

- *All infrastructures (e.g. airport, ground support equipment, airline operator, maintenance…) life cycle*
- *Consumables used during operation of the Business jet (air, de-icing, lubricants...)*
- *Treatment and disposal of waste generated from business jet during operation*
- *Consumption of consumables (lubricants, solvents...) during maintenance phase*
- *Production of catering, food, potable water and other standard items for the operation of the Business jet*

4.2.1.4. End-of-Life module

The following end-of-life scenarios shall be included:

- *Aircraft dismantling activities*
- *Landfilling of materials*
- *Incineration of materials*
- *Transport to End of Life facility (Landfill, Incineration or recycling company)*

The following processes shall be excluded:

- *All infrastructure life cycle*
- *Energy recovery from waste incineration*
- *Recycling operations*

4.2.2 OTHER BOUNDARY SETTING

4.2.2.1. Boundaries in time

PROCESS	BOUNDARIES IN TIME
UPSTREAM	*The life cycle inventory (LCI) data shall be representative for the time period for which the EPD is valid (five years).*
CORE	
OPERATION	
END-OF-LIFE	*LCI data shall be representative for the year/time frame for which the EPD is valid (five years) and shall be based on realistic conditions related to the end-of-life phase.*

Table 4 Boundaries in time

4.2.2.2. Boundaries towards geography

PROCESS	BOUNDARIES TOWARDS GEOGRAPHY
UPSTREAM	*LCI data describing the energy and material inputs and outputs shall be representative for the country or the region in which the processes are taking place. In rare cases when no other information is available global data, e.g. world average values may be used.*
CORE	*The Life Cycle inventory data shall be representative for the site/region where the Business jet is assembled.*
OPERATION	*LCI data describing the energy and material inputs and outputs shall be representative for the country or the region in which the processes are taking place. In rare cases when no other information is available global data, e.g. world average values may be used.*
END-OF-LIFE	

Table 5 Boundaries towards geography

4.2.2.3. Boundaries towards nature

PROCESS	BOUNDARIES TOWARDS NATURE
UPSTREAM	Boundaries to nature are defined as flows of material and energy resources from nature into the system. Emissions to air, water and soil cross the system boundary when they are emitted from or leaving the product system.
CORE	
OPERATION	Boundaries to nature are defined as flows of material and energy resources from nature into the system. Emissions to air, water and soil cross the system boundary when they are emitted from or leaving the product system. *In-flight emissions to air by engines of carbon dioxide shall be considered for the whole flight and based on the profile presented in Appendix B*: Flight profile*.* *Cruising speed as well as cruising altitude(s) considered in the LCA shall be declared.* *In-flight emissions to air by engines of sulphur oxides (SOx), nitrogen oxides (NO_x)[6], unburned hydrocarbons (HC) and carbon monoxide (CO) shall be considered for the landing take-off (LTO) cycle as a minimum, based on ICAO methodology* [10] *and the profile presented in Appendix B*: Flight profile*. LTO is defined in the glossary of terms.* *In-flight emissions to air by auxiliary power unit of carbon dioxide shall be considered based on the APU cycle presented on Appendix C:* APU cycle description
END-OF-LIFE	Boundaries to nature are defined as flows of material and energy resources from nature into the system. Emissions to air, water and soil cross the system boundary when they are emitted from or leaving the product system.

Table 6 Boundaries towards nature

[6] *NO_x are not included at cruise phase as it is not currently a measurable quantity. Work is on-going at ICAO to assess the emissions at cruise phase. NO_x emissions may then be included in next revisions of the PCR.*

4.2.2.4. Boundaries in the life cycle

See Section 4.2.1. The EPD may present the information divided into additional sub-divisions.

4.2.2.5. Boundaries towards other technical systems

See Section 4.5.1.

4.3 SYSTEM DIAGRAM

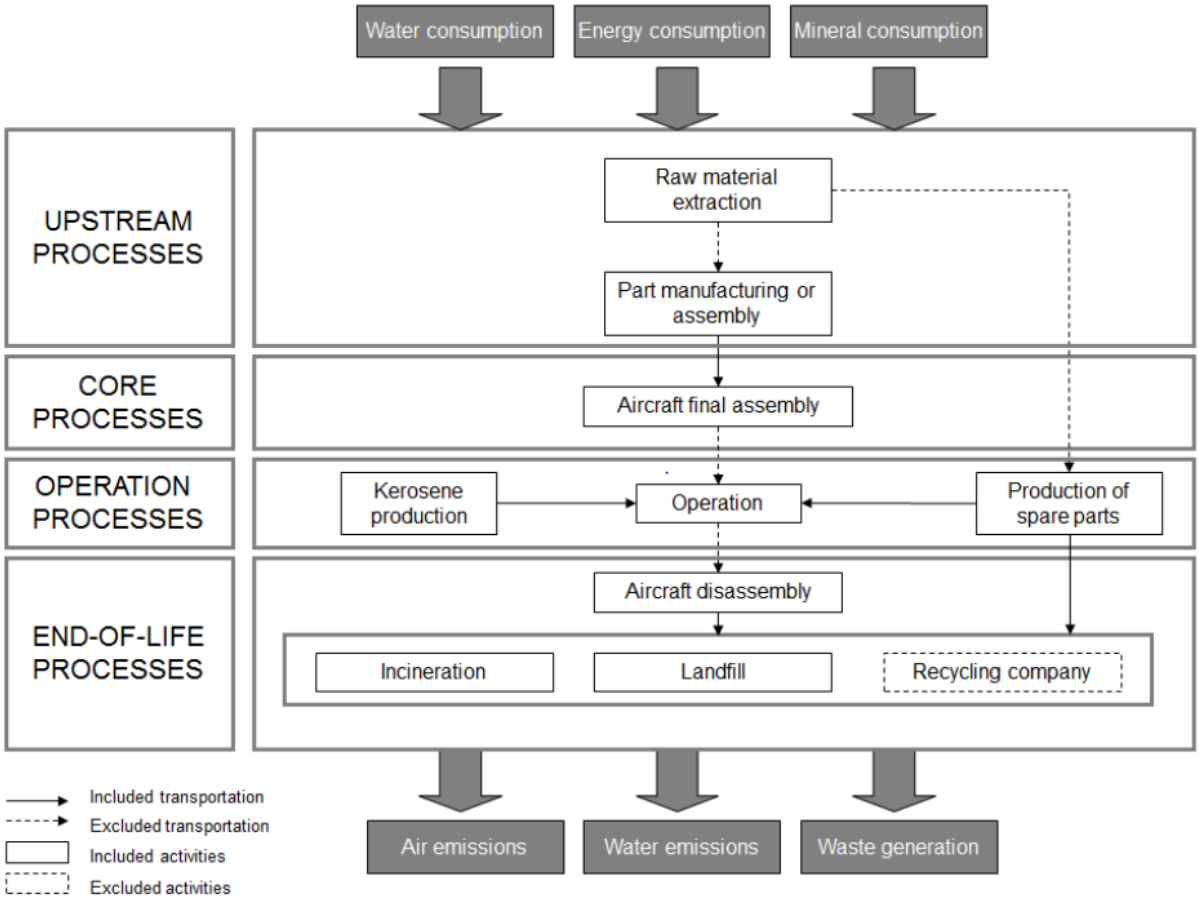

Figure 3 *System diagram illustrating the processes that are included in the product system, divided into upstream, core, operation and end-of-life processes.*

4.4 CUT-OFF RULES

PROCESS	CUT-OFF RULES
UPSTREAM	*All available data shall be included.* *The energy and water consumption, waste generation and treatment from sub-tier-1 suppliers is not mandatory except if more than twenty percentage weight ratio (20 % wt/wt) of the total assembly is outsourced and manufactured in one facility.* *In case a supplier has several facilities where different parts are manufactured, only the energy from the final assembly facility is accounted. However, the other facilities will become as sub-tier-1 suppliers and thus the above cut-off rule is applicable.* *The total mass of the materials shall be included in the LCA report (based on delivered weight empty, see glossary).*
CORE	*Data for elementary flows to and from the product system contributing to a minimum of 99% of the declared environmental impacts shall be included (not including processes that are explicitly outside the system boundary as described in Section 4.2).*
OPERATION	
END-OF-LIFE	

Table 7 Cut-off rules

The check for cut-off rules in a satisfactory way is through the combination of expert judgment based on experience of similar product systems and a sensitivity analysis in which it is possible to understand how the input or output could affect the final results.

4.5 ALLOCATION RULES

PROCESS	ALLOCATION INSTRUCTIONS
UPSTREAM	*If relevant, the allocation of environmental impacts to co-products should be based on a mass criterion. It is also acceptable to use the number of parts produced as allocation criteria. Any other allocation procedures based on the product's physical or chemical characteristics must be justified. The use of economic allocation criteria shall be avoided because of its sensitivity to market specific conditions. The allocation procedures shall be documented in the LCA report.*
CORE	
OPERATION	*Fuel burn and all related calculations* ▪ *100% of fuel burn is attributable to the flight mission purpose* ▪ *Even if fuel reserves shall be considered as per NBAA (as shown on Appendix B: Flight profile) making the aircraft heavier, none of this fuel shall be consumed for the purpose of the mission considered in the LCA.*

Table 8 Allocation instructions

4.5.1 REUSE, RECYCLING, AND RECOVERY

In the framework of the International EPD® System, the methodological choices for allocation for reuse, recycling and recovery have been set according to the polluter pays principle (PPP). This means that the generator of the waste shall carry the full environmental impact until the point in the product's life cycle at which the waste is transported to a scrapyard or the gate of a waste processing plant (collection site). The subsequent user of the waste shall carry the environmental impact from the processing and refinement of the waste but not the environmental impact caused in the "earlier" life cycles. See General Programme Instruction for further information and examples.

4.6 DATA QUALITY REQUIREMENTS

An LCA calculation requires two different kinds of information:

- data related to the **environmental aspects** of the considered system (such materials or energy flows that enter the production system). These data usually come from the company that is performing the LCA calculation.
- data related to the **life cycle impacts** of the material or energy flows that enter the production system. These data usually come from databases.

Data on environmental aspects shall be as specific as possible and shall be representative of the studied process.

Data on the life cycle of materials or energy inputs are classified into three categories – specific data, selected generic data, and proxy data, defined as follows:

- **specific data** (also referred to as "primary data" or "site-specific data") – data gathered from the actual manufacturing plant where product-specific processes are carried out, and data from other parts of the life cycle traced to the specific product system under study, e.g. materials or electricity provided by a contracted supplier that is able to provide data for the actual delivered services, transportation that takes place based on actual fuel consumption, and related emissions, etc.,
- **generic data** (sometimes referred to as "secondary data"), divided into**:**
  - **selected generic data** – data from commonly available data sources (e.g. commercial databases and free databases) that fulfil prescribed data quality characteristics for precision, completeness, and,
  - **proxy data** – data from commonly available data sources (e.g. commercial databases and free databases) that do not fulfil all of the data quality characteristics of "selected generic data".

As a general rule, specific data shall always be used, if available, after performing a data quality assessment. It is mandatory to use specific data for the core processes as defined above. For the upstream module, operation module and the end-of-life module, generic data may also be used if specific data are not available.

PROCESS	DATA QUALITY RULES
UPSTREAM	*Quantification of flows (e.g. The material composition of the whole aircraft, energy and water consumed to manufacture each part of the Business jet and waste generated to manufacture each Business jet part) shall be acquired from and confirmed by tier-1 suppliers for at least 90% of the total mass of the business jet (based on delivered weight empty, see glossary).* *The remaining 10% can be acquired from estimation or literature.* *This 10% rule also applies to transportation of parts.* *Selected generic data representing country or regional averages can be used for cradle to gate material production and energy production processes if specific data is unavailable.* *It is important to emphasize that – in most cases – all available data shall be used. Using cut-off rules should not give the perceptions of "hiding" information, but rather to facilitate the data collection for practitioners.* *The EPD® may include an indicator suitable to demonstrate the relevance of specific, selected generic and other generic data.*
CORE	*Site-specific data shall be used for all core processes including on-site generation of energy if relevant. The electricity mix used in the core processes should be the supplied mix. The energy mix used for electricity generation shall be documented in the LCA report. If such information is not available, the region/country average electricity mix or energy production shall be used.*
OPERATION	*Whenever applicable, data on pollutant emissions from the use phase shall be based on internationally recognized documented tests, i.e.:* ▪ *LTO emissions of nitrogen oxides (NO_x), hydrocarbons (HC) and carbon monoxide (CO) shall be*

<table>
<tr>
<td></td>
<td>
calculated based on ICAO engine certification if applicable.

The following assumptions are made to calculate the emissions:

▪ A factor 3.16 shall be used to derive carbon dioxide emissions from fuel consumption [16].

▪ Nitrogen oxides(NO_x), carbon monoxide (CO) and hydrocarbons (HC) emissions are considered only during the landing/takeoff cycle as defined by ICAO. Emissions are directly taken from certification document for those substances [17].

▪ Kerosene production shall also be integrated in the study. As the aircraft can operate anywhere in the world, a generic global production mix, based on publicly available country-specific statistics from the Energy international agency shall be used. An example of the Kerosen Production statistics is presented in Table 9. A sensitivity analysis shall be conducted on the production country of the kerosene.

▪ Transportation of kerosene from the refinery to the airport where the aircraft will be operated shall also considered with a selected 50 km distance.

Table 9: Kerosene Production statistics (2012) [18]
<table>
<tr><th>Country</th><th colspan="2">Production</th></tr>
<tr><td></td><td>Thousand barrels per day</td><td>% in production mix</td></tr>
<tr><td>Australia</td><td>96</td><td>3</td></tr>
<tr><td>Brazil</td><td>94</td><td>3</td></tr>
<tr><td>China</td><td>291</td><td>9</td></tr>
<tr><td>Germany</td><td>112</td><td>4</td></tr>
<tr><td>India</td><td>219</td><td>7</td></tr>
<tr><td>Japan</td><td>224</td><td>7</td></tr>
<tr><td>Rest of EU-27</td><td>455</td><td>15</td></tr>
<tr><td>UK</td><td>124</td><td>4</td></tr>
<tr><td>US</td><td>1 471</td><td>48</td></tr>
</table>
▪ Standard fuel shall be considered in the LCA as per ASTM D1655 [19].Other types of fuels (biofuels) may be considered for comparison in the EPD. The type of fuel used shall be declared in the EPD.

▪ A kerosene sulfur content of 0.045% shall be considered as measured on average in jet fuel [20]

When these tests are not applicable (aircraft with engine whose rated output is lower than 26.7kN or whose date of manufacture is before 1986), emissions data shall be based on third-party verified studies.

Whenever applicable, ICAO certification data shall be given in the LCA report.
</td>
</tr>
<tr>
<td>END-OF-LIFE</td>
<td>The data used for the Business jet end-of-life shall represent the state of the technological knowledge within the boundaries in time defined in the section 4.2.2.1.</td>
</tr>
</table>

Table 10 Data quality rules

Any data used should preferably represent average values for a specific reference year. However, the way these data are generated could vary, e.g. over time, and in such cases they should have the form of a representative annual average value for a specified reference period. Such deviations should be declared.

4.6.1 RULES FOR USING GENERIC DATA

The attributional LCA approach in the International EPD® System forms the basic prerequisites for selecting generic data. To allow the classification of generic data as "selected generic data", they shall fulfil selected prescribed characteristics for precision, completeness, and representativeness (temporal, geographical, and technological), such as:

- the reference year must be as current as possible and preferably assessed to be representative for at least the validity period of the EPD,
- the cut-off criteria to be met on the level of the modelled product system are the qualitative coverage of at least 99% of energy, mass, and overall environmental relevance of the flows. *Deviation from this rule for the upstream processes is stated in section 4.4.,*
- completeness in which the inventory data set should, in principle, cover all elementary flows that contribute to a relevant degree of the impact categories, and
- the representativeness of the resulting inventory in the given temporal, technological, and geographical reference should, as a general principle, be better than ±5% of the environmental impact of fully representative data.
- *Data calculated with system expansion should not be used, but if no other data is available, any negative flows should be changed to zero.*

Section 4.7 provides a list of recommended databases/data sets to be used for generic data.

If selected generic data that meets the requirements of the International EPD® System are not available as the necessary input data, proxy data may be used and documented. The environmental impacts associated with proxy data shall not exceed 10% of the overall environmental impact from the product system.

The EPD may include a data quality declaration to demonstrate the share of specific data, selected generic data and proxy data for the environmental impacts.

***For the operation module**: generic data shall not be used for in-flight emissions.*

4.7 RECOMMENDED DATABASES FOR GENERIC DATA

Table 11 lists recommended databases for generic data. Please note that this listing does not imply that other data that fulfil the data quality requirements may not be used and that data quality assessment shall also be performed for the data sets in the recommended database by an LCA practitioner.

The following data sources (Table 11) can be used when specific data is not available:

Table 11 Selected generic data sources

MATERIAL/PROCESS	DATABASE
Metals, electricity, fuels, chemicals, transport, waste management	*PE-GaBi* *ELCD* *Ecoinvent*
Plastics	*PE plastics Europe* *PE-GaBi* *ELCD* *Ecoinvent*
Electronic components	*PE-GaBi* *ELCD* *Ecoinvent*

4.8 IMPACT CATEGORIES AND IMPACT ASSESSMENT

The potential environmental impact per functional unit for the following environmental impact categories shall be reported in the EPD, divided into core, upstream, operation and end-of life modules:

- *Emissions of greenhouse gases (expressed as the sum of global warming potential, GWP, 100 years, in carbon dioxide equivalents, kg CO_2 eq.),*
- *Emission of acidifying gases (expressed as the sum of acidification potential expresses in sulphur dioxide equivalents, kg SO_2 eq.)[7],*
- *Emission of gases that contribute to the creation of ground-level ozone, "photochemical oxygen creation potential" (expressed as the sum of ozone-creating potential, in ethylene equivalents, kg C_2H_4 eq.),*
- *Emission of substances to water contributing to oxygen depletion, "eutrophication" (expressed as phosphate, kg PO_4^{3-} eq.).*
- *Water scarcity potential (expressed in water stress index (WSI), m^3 eq.).*

The characterisation models and factors to use for the impact categories are available on www.environdec.com and shall be updated on a regular basis based on the latest developments in LCA methodology and ensuring the market stability of EPDs. The source and version of the characterisation models and the factors used shall be reported in the EPD. Alternative regional life cycle impact assessment methods and characterisation factors are allowed to be calculated and displayed in addition to the default list. If so, the EPD shall contain an explanation of the difference between the different sets of indicators, as they may appear to the reader to display duplicate information. The software together with the generic database used (if applicable) shall also be declared in the EPD.

4.8.1 SPECIFICATION FOR GWP CALCULATIONS

Both emissions to the atmosphere and removals from the atmosphere shall be accounted for the assessment of the overall GHG emissions of the product being assessed. This assessment shall include the gases arising from both fossil and biogenic sources for all products, with the exception of human food and animal feed products. Emissions and removals of biogenic carbon shall be reported separately.

Where some or all removed carbon will not be emitted to the atmosphere, the portion of carbon not emitted to the atmosphere shall be treated as stored carbon. Following issues shall be taken into account:

- *Carbon storage might arise where biogenic carbon forms part or all of a product (e.g. wood fibre in a table), or where atmospheric carbon is taken up by a product over its life cycle (e.g. cement),*
- *While forest management activities might result in additional carbon storage in managed forests through the retention of forest biomass, this potential source of storage is not included in the scope of the International EPD® System*

GHG emissions offset mechanism shall not be used at any point in the assessment of the GHG emissions of the product. The organisation could declare its participation to some offsetting program in the other information section of the EPD® or single issue EPD.

4.9 OTHER CALCULATION RULES AND SCENARIOS

4.9.1 UPSTREAM PROCESSES

The following requirements apply to the upstream processes:

- Data referring to processes and activities upstream in a supply chain over which an organisation has direct management control shall be specific and collected on site.
- Data referring to contractors that supply main parts, or main auxiliaries should be requested from the contractor as specific data.

[7] Please note that for this indicator a CML non-baseline approach is currently recommended. See www.environdec.com for the latest information.

- The transport of main parts and components along the supply chain to a distribution point (e.g. a stockroom or warehouse) where the final delivery to the manufacturer can take place based on the actual transportation mode, distance from the supplier, and vehicle load.
- In case specific data is lacking, selected generic data may be used. If this is also lacking, proxy data may be used.
- For the electricity used in the upstream processes, electricity production impacts shall be accounted for in this priority when specific data are used in the upstream processes:

    1. Specific electricity mix as generated, or purchased, from an electricity supplier, demonstrated by a Guarantee of Origin (or similar, where reliability, traceability, and the avoidance of double-counting are ensured) as provided by the electricity supplier. If no specific mix is purchased, the residual electricity mix from the electricity supplier shall be used.[8]
    2. National residual electricity mix or residual electricity mix on the market
    3. National electricity production mix or electricity mix on the market.

    The mix of electricity used in upstream processes shall be documented in the EPD, where relevant.

4.9.2 CORE PROCESSES

The following requirements apply to the core processes:

- Specific data shall be used for the assembly of the product and for the manufacture of main parts as well as for on-site generation of steam, heat, electricity, etc., where relevant.
- For the electricity used in the core processes, electricity production impacts shall be accounted for in this priority:

    1. Specific electricity mix as generated, or purchased, from an electricity supplier, demonstrated by a Guarantee of Origin (or similar, where reliability, traceability, and the avoidance of double-counting are ensured) as provided by the electricity supplier. If no specific mix is purchased, the residual electricity mix from the electricity supplier shall be used.[9]
    2. National residual electricity mix or residual electricity mix on the market
    3. National electricity production mix or electricity mix on the market.

    The mix of electricity used in the core processes shall be documented in the EPD, where relevant.
- Transport from the final delivery point of raw materials, chemicals, main parts, and components (see above regarding upstream processes) to the manufacturing plant/place of service provision should be based on the actual transportation mode, distance from the supplier, and vehicle load, if available.
- Waste treatment processes of manufacturing waste should be based on specific data, if available.

4.9.3 OPERATION MODULE

The following requirements apply to the operation module:

- Data for the use stage are usually based on scenarios, but specific data should be used when available and relevant.
- Data on the pollutant emissions from the use stage should be based on documented tests, verified studies in conjunction with average or typical product use, or recommendations concerning suitable product use. Whenever applicable, test methods shall be internationally recognised.

[8] The residual electricity mix is the mix when all contract-specific electricity that has been sold to other customers has been subtracted from the total production mix of the electricity supplier.

[9] The residual electricity mix is the mix when all contract-specific electricity that has been sold to other customers has been subtracted from the total production mix of the electricity supplier.

- The transport of spare parts for maintenance to the customer should reflect the actual situation to the best extent possible. The following priority should be used:
    1. Actual transportation distances and types.
    2. Calculated as the average distance of a spare part transported by different means of transport modes.
    3. Calculated as a fixed long transport, such as 1 000 km transport by lorry or truck, or 10 000 km by airplane, according to the spare part.

4.9.4 END-OF-LIFE MODULE

The following requirements apply to the end-of-life module:

- Scenarios for the end-of-life stage shall be technically and economically practicable and compliant with current regulations or best practices (such as AFRA's Best Management Practice guide (BMP) [14]) in the relevant geographical region based on the geographical scope of the EPD. Key assumptions regarding the end-of-life stage scenario shall be documented.
- The transport end-of-life facilities should reflect the actual situation to the best extent possible. The following priority should be used:
    1. Actual transportation distances and types.
    2. Calculated as the average distance of end-of-life parts transported by different means of transport modes.
    3. Calculated as a fixed transport, such as 100 km transport by truck or 1000 km by lorry, according to the part.

5 CONTENT AND FORMAT OF EPD

EPDs based on this PCR shall contain the information described in this section. Flexibility is allowed in the formatting and layout provided that the EPD still includes the prescribed information. A generic template for EPDs is available via www.environdec.com

As a general rule the EPD content:

- shall be in line with the requirements and guidelines in ISO 14020 [21] (Environmental labels and declarations - General principles),
- shall be verifiable, accurate, relevant and not misleading, and
- shall not include rating, judgements or direct comparison with other products.

An EPD should be made with a reasonable number of pages for the intended audience and use.

5.1 EPD LANGUAGES

EPDs should be published in English, but may also be published in additional languages. If the EPD is not available in English, it shall contain an executive summary in English including the main content of the EPD. This summary is part of the EPD and thus subject to the same verification procedure.

5.2 UNITS AND QUANTITIES

The following requirements apply for units and quantities:

- The International System of Units (SI units) shall be used, e.g., kilograms (kg), Joules (J) and metres (m). Reasonable multiples of SI units may be decided in the PCR to improve readability, e.g., grams (g) or megajoules (MJ). The following exceptions apply:
  - Resources used for energy input (primary energy) should be expressed as kilowatt-hours (kWh) or megajoules (MJ), including renewable energy sources, e.g., hydropower, wind power and geothermal power.
  - Water use should be expressed in cubic metres (m^3)
  - Temperature should be expressed in degrees Celsius (°C),
  - Time should be expressed in the units most practical, e.g., seconds, minutes, hours, days or years.
- Three significant figures[10] should be adopted for all results. The number of significant digits shall be appropriate and consistent.
- The thousand separator and decimal mark in the EPD shall follow one of the following styles (a number with six significant figures shown for illustration):
  - SI style (French version): 1 234,56
  - SI style (English version): 1 234.56

  In case of potential confusion or intended use of the EPD in markets where different symbols are used, the EPD shall state what symbols are used for thousand separator and decimal mark.
- Dates and times presented in the EPD should follow the format in ISO 8601 [22]. For years, the prescribed format is YYYY-MM-DD, e.g., 2017-03-26 for March 26th, 2017.
- The result tables shall:
  - Only contain values or the letters “INA” (Indicator Not Assessed). It is not possible to specify INA for mandatory indicators. INA shall only be used for voluntary parameters that are not quantified because no data is available.[11]

[10] Significant figures are those digits that carry meaning contributing to its precision. For example with two significant digits, the result of 123.45 shall be displayed as 120, and 0.12345 shall be displayed as 0.12. In scientific notation, these two examples would be displayed as $1.2*10^2$ and $1.2*10^{-2}$.

- Contain no blank cells, hyphens, less than or greater than signs or letters (except “INA”).
- Use the value 0 only for parameters that have been calculated to be zero.
- Footnotes shall be used to explain any limitation to the result value.

5.3 USE OF IMAGES IN EPD

Images used in the EPD, especially pictures featured on the cover page, may in themselves be interpreted as an environmental claim. Images such as trees, mountains, wildlife that are not related to the declared product should therefore be used with caution and in compliance with national legislation and best available practices in the markets in which the EPD is intended to be used.

5.4 EPD REPORTING FORMAT

The reporting format of the EPD shall include the following sections:

- Cover page (see Section 5.4.1)
- Programme information (see Section 5.4.2)
- Product information (see Section 5.4.3)
- Content declaration (see Section 5.4.4)
- Environmental performance (see Section 5.4.5)
- Additional environmental information (see Section 5.4.6)

References (see Section 5.4.9)

The following information shall be included, when applicable:

- Information related to Sector EPDs (see Section 5.4.7)
- Differences versus previous versions (see Section 5.4.8)
- Executive summary in English (see Section 5.4.10)

5.4.1 COVER PAGE

The cover page shall include:

- Product name and image,
- Name and logotype of EPD owner,
- The text “Environmental Product Declaration” and/or “EPD”
- *Programme: The International EPD® System, www.environdec.com,*
- *Programme operator: EPD International AB*
- Logotype of the International EPD® System,
- EPD registration number as issued by the programme operator[12],
- *Date of publication (issue): 20XX-YY-ZZ,*

[11] This requirement does not intend to give guidance on what indicators are mandated (“shall”) or voluntary.

[12] The EPD shall not include a “registration number” if such is provided by the certification body, as this may be confused with the registration number issued by the programme operator.

- *Date of revision: 20XX-YY-ZZ*, when applicable,
- *Date of validity; 20XX-YY-ZZ*
- A note that "*An EPD should provide current information, and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com*."
- A statement of conformity with ISO 14025 [2],

5.4.2 PROGRAMME INFORMATION

The programme information section of the EPD shall include:

- Address of programme operator: *EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden, E-mail: info@environdec.com*
- The following mandatory statement from ISO 14025: "*EPDs within the same product category but from different programmes may not be comparable*."
- A statement that the EPD owner has the sole ownership, liability and responsibility of the EPD
- Information about verification[13] and reference PCR in a table with the following format and contents:

Product category rules (PCR): *<name, registration number, version and UN CPC code(s)>*
PCR review was conducted by: *<name and organisation of the review chair, and information on how to contact the chair through the programme operator>*
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☐ EPD verification
Third party verifier: *<name, organisation and signature of the third party verifier>* *In case of certification bodies:* Accredited by: *<name of the accreditation body and accreditation number, if applicable>.* *In case of individual verifiers:* Approved by: The International EPD® System Technical Committee, supported by the Secretariat
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☐ No

5.4.3 PRODUCT INFORMATION

The product information section of the EPD shall include:

- Address and contact information to EPD owner,
- Description of the organisation. This may include information on products- or management system-related certifications (e.g. ISO 14024 Type I environmental labels, ISO 9001- and 14001-certificates and EMAS-registrations) and other relevant work the organisation wants to communicate (e.g. SA 8000, supply-chain management and social responsibility),

[13] If the EPD has been verified by an approved individual verifier who has received contractual assistance from a certification body that is not accredited, this certification body shall not be included in this table.

- Name and location of production sites,
- Product identification by name, and an unambiguous identification of the product by standards, concessions or other means,
- *Type of Business jet (Light, Medium or Large)*
- Identification of the product according to the UN CPC scheme system. Other relevant codes for product classification may also be included, e.g.
  - Common Procurement Vocabulary (CPV),
  - United Nations Standard Products and Services Code® (UNSPSC),
  - Classification of Products by Activity (NACE/CPA) or
  - Australian and New Zealand Standard Industrial Classification (ANZSIC),
- Description of the product, its application/intended use and technical functions, e.g. expected service life time,
- *Cabin volume considered in the LCA study*
- *Number of flights cycles and flight hours that the aeroplane can perform in its entire life (based on the certification)*
- *Complete layout of declared interior configuration considered in the LCA*
- *Main specifications of the product (according to Table 3)*
- *A simple visual representation or image of the product*
- *Description of content declaration according to Chapter 5.4.4*
- Geographical scope of the EPD, i.e., for which geographical location(s) of use and end-of-life the product's performance has been calculated,
- Functional unit or declared unit,
- Declaration of the year(s) covered by the data used for the LCA calculation and other relevant reference years,
- Reference to the main database(s) for generic data and LCA software used, if relevant,
- System diagram of the processes included in the LCA, divided into the life cycle stages,
- Description if the EPD system boundary is "cradle-to-gate", "cradle-to-gate with options" or "cradle-to-grave",
- Information on which life cycle stages are not considered (if any), with a justification of the omission,
- Relevant websites for more information or explanatory materials.

This section may also include:

- Name and contact information of organisation carrying out the underlying LCA study,
- Additional information about the underlying LCA-based information, such as assumptions, cut-off rules, data quality and allocation.
- *Manufacturer logotype*
- *Message from the CEO*

Any claim made about the product must be verifiable.

5.4.4 CONTENT DECLARATION

Content declaration of materials:

The content declaration of materials (based on the delivered weight empty (DWE), see glossary) shall be declared in the EPD at a minimum of 90 % of one aircraft and shall be classified into the following categories as a minimum, adapted from ISO22628 [13]*:*

- *Metals*
- *Polymers*
- *Elastomers*
- *Fluids (liquids and gases)*
- *Others (Electronics, coating…)*

Fibre reinforced polymers materials (carbon fibre reinforced polymer, glass fibre reinforced polymer, aramid) shall be classified as polymers.

A detailed material report shall be part of the LCA report by alloy type.

Content declaration concerning hazardous properties:

Since the aerospace industry is highly regulated by safety and that a declaration of hazardous properties of materials and chemical substances requires the publication of sensitive data from suppliers, it is suggested to disclose these substances under a contract or a non-disclosure agreement to the end users. This content declaration shall be included in the EPD ***ONLY IN THE EVENT*** *the aerospace industry reaches to a consensus on hazardous substances public disclosure.*

5.4.4.1. Information about recycled materials

When a product is made in whole or in part with recycled materials, the provenience of the materials (pre-consumer or post-consumer) shall be presented in the EPD as part of the content declaration.

To avoid any misunderstanding about which material may be considered “recycled material”, the guidance given in ISO 14021 [23] shall be taken into account. In brief, the standard states that:

- only pre-consumer or post-consumer materials (scraps) shall be considered in the accounting of the recycled materials, and
- materials coming from scrap reutilisation (such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it) shall not be considered as recycled content.

5.4.5 ENVIRONMENTAL PERFORMANCE

5.4.5.1. Environmental impacts

The indicators related to potential environmental impact listed in Table 12 shall be declared per functional unit or declared unit, and per life cycle stage.

PARAMETER	UNIT	UPSTREAM	CORE	OPERATION	END-OF-LIFE	TOTAL
Global warming potential (GWP)	kg CO_2 eq.					
Acidification potential (AP)	kg SO_2 eq.					
Eutrophication potential (EP)	kg PO_4^{3-} eq.					
Formation potential of tropospheric ozone (POCP)	kg C_2H_4 eq.					
Water scarcity potential	m^3 eq.					

Table 12 Indicators describing potential environmental impacts[14].

5.4.5.2. Use of resources

The indicators for resource use based on the life cycle inventory (LCI) listed in Table 13 shall be declared per functional unit or declared unit, and per life cycle stage.

PARAMETER		UNIT	UPSTREAM	CORE	OPERATION	END-OF-LIFE	TOTAL
Primary resources – Renewable	Energy	MJ					
	Materials	kg					
Primary resources – Non-renewable	Energy	MJ					
	Materials	kg					
Water consumption		kg					

Table 13 Indicators describing use of resources.

Notes:

- In order to identify the primary energy used as an energy carrier (and not used as raw materials), the parameter may be calculated as the difference between the total input of primary energy and the input of energy resources used as raw materials.
- Energy content of biomass used for feed or food purposes shall not be considered.
- The water consumption does not constitute a “water footprint” [24] as potential environmental impacts due to the water use in different geographical locations is not captured. For this indicator:
  - Evaporation, transpiration, product integration, release into different drainage basins or the sea, displacement of water from one water resource type to another water resource type within a drainage basin (e.g. from groundwater to surface water) is included.
  - In-stream water use is not included.
  - For water used in closed loop processes (such as cooling system) and in power generation only the net water consumption (such as reintegration of water losses) should be considered.
  - Seawater shall not be included
  - Tap water or treated water (e.g. from a water treatment plant), or wastewater that is not directly released in the environment (e.g. sent to a wastewater treatment plant) are not elementary water flows, but intermediate flows from a process within the technosphere.
  - Additional transparency in terms of geographical location, type of water resource (e.g. groundwater, surface water), water quality and temporal aspects may be included as additional information.

5.4.5.3. Waste production and output flows

Waste generated along the whole life cycle production chains shall be treated following the technical specifications described in the Genera. When the amount of waste or the output flows is from the life cycle inventory (LCI) are declared, the indicators in Table 14 shall be reported per functional unit or declared unit, and per life cycle stage. In Table 15, per functional unit or declared unit.

[14] Please check www.environdec.com for the latest list of default impact categories, units and characterisation factors as they may have been updated compared to this table.

PARAMETER	UNIT	UPSTREAM	CORE	OPERATION	END-OF-LIFE	TOTAL
Hazardous waste disposed	kg					
Non-hazardous waste disposed	kg					
Radioactive waste disposed	kg					

Table 14 Indicators describing waste production.

PARAMETER	UNIT	TOTAL
Materials for recycling	% wt./wt.	
Materials for energy recovery	% wt./wt.	
Materials for landfill	% wt./wt.	

Table 15 Indicators describing output flows.

Notes:

- Materials for energy recovery with an efficiency rate below 60% are not considered materials for energy recovery (European Guideline on R1 energy interpretation), and is allocated within the system boundary.

5.4.5.4. Aeroplane fuel consumption

The block fuel as well as the reserves shall be reported in the EPD and shall be based on the flight profile presented in Appendix A: Mission selection in the PCR. *The block fuel shall be reported in Litres per functional unit.*

5.4.5.5. Other environmental indicators

The reference PCR may add other environmental indicators to include for the product category from the inventory or impact assessment. Such indicators should be based on international standards or similar methodologies developed in a transparent procedure. Reference to the chosen indicators and methodologies shall be reported.

5.4.5.5.1. Noise emissions

The noise emissions of the aeroplane shall be declared in accordance with ICAO, Annex 16, Volume I [11] [12] *at the three following points:*

- *Flyover*
- *Lateral*
- *Approach*

Noise emissions shall be reported in EPNdB and shall be declared against the relevant noise limit as per certification document. The limit used shall be stated in the EPD.

A database compiling all noise certification data can be found on http://noisedb.stac.aviation-civile.gouv.fr/. [15]

[15] The following database shall only be used for information purposes

5.4.5.5.2. Potential recyclability and recoverability

The industry is currently actively looking for standards regulating end of life of aeroplanes. Consequently, recyclability and recoverability rates of the aeroplane shall be declared in the EPD according to ISO 22628 methodologies for road vehicles [13].

5.4.5.5.3. Water vapour emissions

Water vapour is emitted during the flight and shall be declared in the EPD. Water vapour's quantity can be derived directly from the fuel burned as follows: 1 260 gwater/kgfuelburned [25]

Emission of water vapour at high altitudes will produce contrails. The contrails themselves are involved in the formation of high altitude cirrus clouds, which are believed to have a warming or cooling effect on the atmosphere. However, in-situ water vapour's Global Warming Potential quantification remains expensive, complex, changing following atmospheric conditions and poorly understood. Thus, water vapour's Global Warming Potential (GWP) has been excluded from the present PCR.

The EPD shall include the following statement:

"These results are only valid for this range and this configuration. No linear assumption can be made to extrapolate potential environmental impacts for another distance, another configuration or another aeroplane type."

5.4.6 ADDITIONAL INFORMATION

Relevant Type I and Type II environmental labels awarded to the product may be stated; and any claims made about the product must be verifiable.

Any additional information that is identified as an important environmental aspect of the Business jet can be addressed in the EPD, e.g. fuel consumption data for several ranges or for several configurations. In the case of the addition of other environmental information, the methodology used shall be declared in the EPD and the LCA report.

In particular, if the carbon footprint is given, the assessment methodology used shall be based on the ISO 14067 technical specification [26].

5.4.7 INFORMATION RELATED TO SECTOR EPDS

For sector EPDs, the following information shall also be included:

- a list of the contributing manufacturers that the Sector EPD covers,
- a description of how the selection of the sites/products has been done and how the average has been determined, and
- a statement that the document covers average values for an entire or partial product category (specifying the percentage of representativeness) and, hence, the declared product is an average that is not available for purchase on the market.

5.4.8 DIFFERENCES VERSUS PREVIOUS VERSIONS

For EPDs that have been updated, the following information shall also be included:

- a description of the differences versus previously published versions, e.g. a description of the percentage change in results and the main reason for the change;
- a revision date on the cover page

5.4.9 REFERENCES

This section shall include a list of references, including the General Programme Instructions (including version number), standards and PCR (registration number, name and version).

The following references shall also be indicated in the EPD:

- *The underlying LCA*
- *Other documents that verify and complement the EPD*
- *Instruction for recycling, if relevant*

5.4.10 EXECUTIVE SUMMARY IN ENGLISH

For EPDs published in another language than English, an executive summary in English shall be included.

The executive summary should contain relevant summarised information related to the programme, product, environmental performance, additional information, information related to sector EPDs, references and differences versus previous versions.

6 GLOSSARY

Allocation	*Partitioning the input or output flows of a process or product system between the product system under study and one or more other product systems*
Balanced field length (BFL)	*Hypothetical length of runway for which the available take-off distance (TOD) equals the emergency distance available (EMD).*
Basic material	*Materials typically used in an aircraft by opposition to raw materials, e.g. aluminium is the basic material made of the bauxite raw material*
Co-product	*Any of two or more products coming from the same unit process or product system*
Cruising speed	*Normal operating speed of an aeroplane in level flight at typical cruising altitude.*
Cut-off criteria	*Specification of the amount of material or energy flow or the level of environmental significance associated with unit processes or product systems to be excluded from a study.*
Data quality	*Characteristics of data that relate to their ability to satisfy stated requirements.*
Delivered Weight Empty (DWE)	*The DWE consists of manufacturer's weight empty (MWE), all fixed interior equipment (both standard and optional) and customer options.*
EPD® system	*The international EPD® system is a communication tool for international markets. It has, as a main objective, the ambition to help and support organizations to communicate the environmental performance of their product (goods and services) in a credible and understandable way. See more details at www.environdec.com*
Fuel	*Any substance burned as a source of heat or power, such as coal, petrol or natural gas.*
Functional unit	*Quantified performance of a product system for use as a reference unit.*
Generic data	*Also referred to as secondary data- data from commonly available sources (e.g. commercial databases and free databases), which are allowed to be used to substitute specific data providing if they fulfil prescribed characteristics.*
Impact category	*Class representing environmental issues of concern to which life cycle inventory analysis results may be assigned.*
Infrastructure	*Stock of fixed capital equipment including factories, roads, etc. (Source: Collins Dictionary). ATAG includes in the term infrastructure "airports, facilities and other facilities" (Source: ATAG).*
Landing-Takeoff Cycle (LTO)	*The operational LTO cycle describes the movements of an aeroplane between ground and 3000 ft.* [27]
Life Cycle Assessment	*Compilation of life cycle inventories involving the gathering and quantification of inputs and outputs for a product system throughout its entire life cycle.*
Manufacturer's weight empty (MWE)	*The MWE consists of the weight of the structure, power plant, systems and interior provisions as defined in the type specification. The MWE excludes the engine oil and unusable fuel.*
Maximum operating altitude	*The maximum flight level at which an aircraft has a near-zero rate of climb at best rate of climb speed and climb power or thrust.*
Maximum Takeoff Weight (MTOW)	*The highest aeroplane loaded weight allowable for the engine power available under the given conditions.*
Operating Weight Empty (OWE)	*The OWE consists of DWE plus Operating items*

Operational items	*Personnel, equipment, and supplies necessary for a particular operation but not included in basic empty weight. These items may vary for a particular aircraft and may include, but are not limited to, the following: Crewmembers, supernumeraries, and bags; Manuals and navigation equipment; Passenger service equipment, including pillows, blankets, and magazines; Removable service equipment for cabin, galley, and bar; Food and beverage, including liquor; Usable fluids, other than those in useful load; Required emergency equipment for all flights; Life rafts, life vests, and emergency transmitters; Aircraft unit load devices; Potable water; Drainable unusable fuel; Spare parts normally carried aboard and not accounted for as cargo; and all other equipment considered standard by the operator.*
Process	*Set of interrelated or interacting activities that transform inputs into outputs.*
Range	*Operating distance of an aeroplane carrying a given number of passengers with a defined accommodation comfort and fuel, including required reserves. Distance is calculated between take-off and landing (as shown on Appendix A: Mission selection in the PCR)*
Specific data	*Also referred as primary data- data gathered from the actual manufacturing plant where product specific processes are carried out.*
Standard items	*Equipment and fluids not considered an integral part of a particular aircraft and not a variation for the same type of aircraft. These items may include, but are not limited to, the following: Unusable fuel and other unusable fluids; Engine oil; Toilet fluid and chemical; Fire extinguishers, pyrotechnics, and emergency oxygen equipment; Structure in galley, buffet, and bar; and Supplementary electronic equipment.*
System boundary	*Set of criteria specifying which unit processes are part of a product system.*
Tier-1 supplier	*Supplier that contracts directly with an Original Equipment Manufacturer (OEM), no matter what it supplies. Sub-tier-1 supplier refers to any supplier in the First-tier Supplier's supply chain.*
Turbofan engine	*A turbojet engine in which additional propulsive thrust is gained by extending a portion of the compressor or turbine blades outside the inner engine case. The extended blades propel bypass air, which flows along the engine axis but between the inner and outer engine casing. This air is not combusted but does provide additional thrust (30 to 40 percent), caused by the propulsive effect imparted to it by the extended compressor blading.*
Turbojet engine	*A jet engine incorporating a turbine-driven air compressor to take in and compress the air for the combustion of fuel, the gases of combustion of fuel, being used both to rotate the turbine and to create a thrust-producing jet.*
Unit process	*Smallest element considered in the life cycle inventory analysis for which input and output data are quantified.*
Waste	*Any material leaving the company to be recycled, landfilled or incinerated. This indicator is usually tracked and declared in environmental reports (EN22 indicator).*

7 ABBREVIATIONS

APU	*Auxiliary Power Unit*
ASTM	*American Society for Testing and Materials*
ATAG	*Air Transport Action Group*
BFL	*Balanced Field Length*
CAAC	*Civil Aviation Administration of China*
CFC	*ChloroFluoroCarbon*
CFRP	*Carbon Fiber Reinforced Plastics*
CO_2	*Carbon dioxide*
CPC	*Central product classification*
EPNdB	*Effective Perceived Noise (Decibel)*
DWE	*Delivered Weight Empty*
EASA	*European Aviation Safety Agency*
EMAS	*Eco-Management and Audit Scheme*
EMD	*Emergency Distance*
EPD	*Environmental Product Declaration*
FAA	*Federal Aviation Administration*
GFRP	*Glass Fiber Reinforced Plastics*
GPI	*General Programme Instructions for environmental product declarations*
GWP	*Global Warming Potential*
HC	*Hydrocarbon*
ICAO	*International Civil Aviation Organization*
IEC	*International EPD Consortium*
ILCD	*International reference Life Cycle Data system*
ISA	*International Standard Atmosphere*
ISO	*International Standard Organization*
kg	*kilogram*
LCA	*Life Cycle Assessment*
LCI	*Life Cycle Inventory*
LOPA	*Layout Passenger Accommodation*
LRC	*Long Range Cruise*
LTO	*Landing Take-Off*
MTOW	*Maximum Take-Off Weight*
MWE	*Manufacturer's Weight Empty*
NO_x	*Nitrogen Oxides*

OWE	*Operating Weight Empty*
PCR	*Product Category Rules*
PMI	*PCR Module Initiative*
PP	*Polluter Pays*
SI	*The International System of Units*
SO2	*Sulphur dioxide*
TCDS	*Type Certificate Data Sheet*
TOD	*Take-Off Distance*
TOFL	*Take-Off Field Length*
UN	*United Nations*
UNCPC	*United Nations Central Product Classification*
VOC	*Volatile Organic Compound*

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8 VERSION HISTORY OF PCR

VERSION 1.0, 2018-11-23

Original version published.

VERSION 1.01, 2018-11-23

Editorial corrections.

VERSION 1.02, 2018-11-27

Editorial corrections.

VERSION 1.03, 2019-09-06

- Clarified terms of use
- Editorial changes

VERSION 1.0.4, 2023-05-16

- Validity period extended with 1 year due to the initiation of an updating process.

9 APPENDIX A: MISSION SELECTION IN THE PCR

Type III environmental declarations allow customer to compare the whole life cycle environmental performance of products. Therefore, comparability of EPDs is critical[16].

The scope of this PCR includes light, medium and large Business jet categories. Knowing that the environmental performance depends on the mission selected, the following representative average mission's lengths have been defined and consequently shall be chosen

Business jet category	***Average mission's length***
Light	*926 km (500 nm)*
Medium	*1 482 km (800 nm)*
Large	*2 408 km (1 300 nm)*

As stated in paragraph "Additional Information" 5.4.6, the declaration of results for other missions is encouraged and should be carried out if found relevant.

[16] *ISO14025,"Environmental labels and declarations-Type III environmental declarations-Principles and procedures," 2006.*

10 APPENDIX B: FLIGHT PROFILE

Based on the National Business Aviation Association (NBAA) Management Guide17, which describes best practices accepted by business aviation community, the Flight Profile shown in *Figure 4* shall be considered to calculate the block fuel as well as in-flight emissions in the LCA.

As a minimum input, the block fuel and emissions shall be reported at selected range as per APPENDIX A. Additional values should be provided at typical or maximum design ranges, in line with aircraft full capability or to best illustrate aircraft optimum efficiency potential.

Engine emissions shall be measured under normal operation conditions as shown on *Figure 4* below:

Segment	Flight Segment
A-B	Taxi-out. All engines idle. (0:10 min)
B-C	Takeoff. Full power. (0:01 min)
C-D	Optimum R/C en route to 1st step cruise.
D-E	Normal cruise power, 1st step cruise.
E-F	Optimum R/C en route to 2nd step cruise.
F-G	Normal cruise power, 2nd step cruise.
G-H	Optimum R/C en route to 3rd step cruise.
H-I	Normal cruise power, 3rd step cruise.
I-J	Descend en route to sea level, 914.14 m/min (3000 fpm) max. and land.
J-K	Taxi-in. (0:05 min)

Conditions
All airport at sea level;
Entire flight at ISA and zero wind;
Maximum of three cruising levels permitted;
Speed in km/h / distances in km;
Fuel density 0.804 kg/l (6.71 lb./US gal)

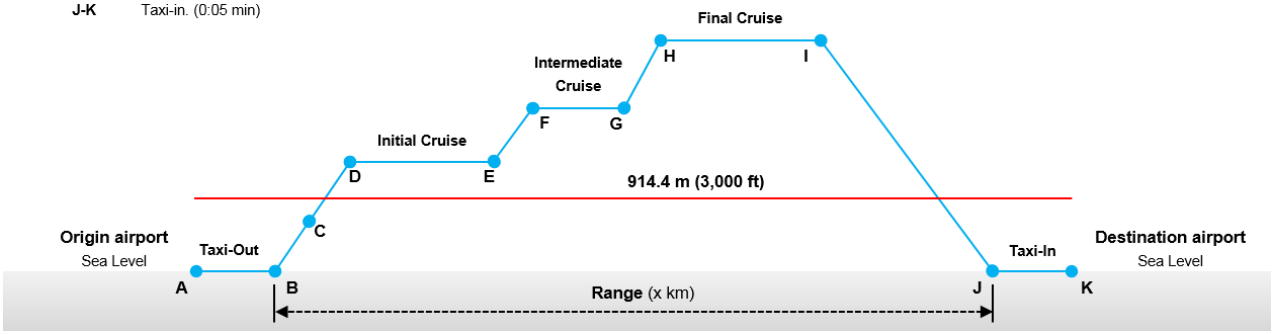

Figure 4: Flight profile to use in the LCA and EPD. LTO cycle is shown under the red line

Fuel reserves are considered as a dead weight in the aircraft and are not considered as burnt during the flight. Reserves shall be calculated according to NBAA management guide.

17 The NBAA Management Guide is an industry how-to manual for business aviation management. Recognized as one of NBAA's most popular member benefits, this publication assists flight departments with operational, maintenance, administrative and other considerations. Much of the information contained in this guide may be used as reference material to educate non-aviation company personnel on accepted practices and norms of the business aviation community.

11 APPENDIX C: APU CYCLE DESCRIPTION

The selected APU flight duty cycle that shall be used in the LCA is defined as follows:

- *Pull up/down: 15 min*
- *Steady State: 35 min*
- *Main Engine Start (MES): 5 min*
- *Steady State: 60 min*

APU emissions shall be measured at sea level, ISA conditions.

When the Business jet does not have APU, then energy and/or fuel type and consumption on ground from: external power generator, tug, or pneumatics system shall be declared and used.

Based on this information, the resulting fuel burn and CO_2 emissions shall be calculated and integrated into LCA analysis.

