



ENGINEERING
TOMORROW

Danfoss

Environmental **Product Declaration**

ABQM 4.0 DN 15 - 32 with AME 110



| | |
|--------------------------------------|--|
| EPD issued | 27.01.2023 |
| EPD expires | 27.01.2028 |
| EPD author | Danfoss Climate Solutions |
| EPD type | Cradle-to-grave |
| Declared unit | One product over its Reference Service Life |
| Products included | ABQM 4.0. DN 15, 20, 25 & 32 pressure independent valve with AME 110 actuator |
| Manufacturing Location | Ljubljana, Slovenia |
| Use Location | European Union |
| Application | HVAC systems |
| Mass | Depending on the size (shown in product composition) |
| Dimensions (H×W×D) | Depending on the size (shown in product composition) |
| Verification | <input type="checkbox"/> External <input checked="" type="checkbox"/> Internal <input type="checkbox"/> None |
| Produced to | Danfoss Product Category Rules (2022-09) |
| Internal independent verifier | Danfoss Power electronics A/S |

DISCLAIMER

This EPD was prepared to the best of knowledge of Danfoss A/S. The life cycle assessment calculations were performed in accordance with ISO 14040 & 14044 and EN15804+A2.

All results were internally reviewed by independent experts. While this declaration has followed the guidance of ISO 14025, it has not been externally verified or registered by an EPD programme and therefore does not fully comply with the ISO 14025 standard.

This EPD has been published by Danfoss A/S on Danfoss Product Store and Danfoss Website. For questions, feedback or requests please contact your Danfoss sales representative.

Introduction

This Environmental Product Declaration (EPD) follows the Danfoss Product Category Rules (PCR) (2022-09-20). These rules provide a consistent framework for calculating and reporting the environmental performance of Danfoss' products and is aligned with relevant international standards, particularly ISO 14025:2006, EN 15804+A2:2019 and EN 50598-3:2015.

This document has been produced by Danfoss A/S following an internal verification process, but it is not a third-party verified document.

What is an EPD?

An EPD is a document used to communicate transparently, the quantified environmental impacts of a product over its lifecycle stages. This quantification is done by performing a Life Cycle Assessment (LCA) in line with a consistent set of rules known as a PCR (Product Category Rules).

An EPD provides:

- A product's carbon footprint together with other relevant environmental indicators, including air pollution, water use, energy consumption and waste, over its own life cycle (Modules A-C), as well as the expected benefits of reuse and recycling in reducing the impact of future products (Module D). See Table 1 for module descriptions.
- Environmental data allowing customers to calculate LCAs and produce EPDs for their own products.

Type of EPD

This EPD is of the type 'cradle-to-grave' and includes all relevant modules: production (A1-A3), shipping (A4) and installation (A5); operational energy use (B6); deconstruction (C1), waste collection and transport (C2), treatment (C3) and disposal (C4). It also includes potential net benefits to future products from recycling or reusing post-consumer waste (D). The codes in brackets are the module labels from EN 15804+A2. Modules concerning use, maintenance, repair, replacement, refurbishment (B1-B5) and operational water use (B7) are excluded, following the cut-off rules from EN 15804.

Table 1: Modules of the product's life cycle included in the EPD

| Product stage | | | Installation | | Use stage | | | | | | | End-of-life stage | | | | Benefits |
|---------------|-----------|-------------|--------------|--------------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|-------------------|-----------|------------------|----------|--|
| Raw materials | Transport | Manufacture | Transport | Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-install. | Transport | Waste processing | Disposal | Benefits and loads outside system boundaries |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | X | X | MNR | MNR | MNR | MNR | MNR | X | MNR | X | X | X | X | X |

(X = declared module; MNR = module not relevant)

Product Description

AB-QM 4.0 DN15-DN32 valve: The Danfoss AB-QM is a Pressure Independent Control Valve (PICV) that combines high accuracy and durability with market leading user-friendliness. Pressure independent valves are control valves with an automatic balancing function. An in-built pressure controller keeps a constant differential pressure over the control valve, ensuring full authority and automatic flow limitation. By combining two functions in one, control and automatic hydronic balance, Danfoss AB-QM provide a cost-efficient solution for the challenges faced by forward-looking designers of HVAC systems.

AME 110 NL actuator: AME 110 NL is a high accuracy analog gear actuator, specifically designed for use with the Pressure Independent Balancing Control Valve type AB-QM in sizes from DN 15-32. This enables accurate pressure independent HVAC control performance, offering designers, system integrators and building owners many features and benefits. See more information on [Danfoss product store](#) and [Danfoss product store](#).



Figure 1: The exploded illustration of the drive with its main components.

Reference Service Life

For the purpose of this EPD the reference service life (RSL) of the product is considered to be 10 years. However, with the correct maintenance, the lifetime of the product can reach over 15 years.

Intended market

The intended market of this study is European Union, and the baseline scenario involves the distribution, installation, and end-of-life in European Union. With regards to the use stage and the end-of-life stage, this EPD is not representative of regions other than European Union.

Product Description

Table 2: Product composition ABQM 4.0 DN 15 - 32 & AME 110

| Material | DN 15 & AME 110 | | DN 20 & AME 110 | | DN 25 & AME 110 | | DN 32 & AME 110 | |
|-------------------------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|
| | Mass (kg) | (%) | Mass (kg) | (%) | Mass (kg) | (%) | Mass (kg) | (%) |
| Metals | 0,646 | 80,72 % | 0,858 | 84,69% | 1,281 | 87,72% | 1,723 | 89,60% |
| Steel (excl. stainless steel) | 0,006 | 0,75% | 0,006 | 0,59% | 0,006 | 0,41% | 0,006 | 0,31% |
| Stainless steel | 0,010 | 1,26% | 0,010 | 1,00% | 0,071 | 4,84% | 0,108 | 5,62% |
| Brass | 0,630 | 78,70 % | 0,842 | 83,10% | 1,204 | 82,47% | 1,609 | 83,67% |
| Plastics & Rubbers | 0,094 | 11,72 % | 0,095 | 9,34% | 0,119 | 8,13% | 0,139 | 7,22% |
| Ultradur | 0,015 | 1,88% | 0,015 | 1,48% | 0,015 | 1,03% | 0,015 | 0,78% |
| ABS | 0,003 | 0,41% | 0,003 | 0,30% | 0,003 | 0,21% | 0,003 | 0,16% |
| EPDM_Ext | 0,0021 | 0,26% | 0,003 1 | 0,31% | 0,005 0 | 0,34% | 0,005 0 | 0,26% |
| NBR_Ext | 0,0001 | 0,01% | 0,000 1 | 0,01% | 0,000 1 | 0,01% | 0,000 1 | 0,01% |
| PA66 | 0,0012 | 0,15% | 0,001 2 | 0,12% | 0,001 2 | 0,08% | 0,001 2 | 0,06% |
| PA66_GF | 0,0020 | 0,25% | 0,002 0 | 0,20% | 0,002 0 | 0,14% | 0,002 0 | 0,10% |
| POM | 0,0325 | 4,06% | 0,032 5 | 3,21% | 0,032 5 | 2,23% | 0,032 5 | 1,69% |
| Cycoloy | 0,0100 | 1,25% | 0,010 0 | 0,99% | 0,010 0 | 0,69% | 0,010 0 | 0,52% |
| PP | 0,0166 | 2,08% | 0,016 8 | 1,65% | 0,039 0 | 2,67% | 0,058 9 | 3,06% |
| PS | 0,0110 | 1,38% | 0,011 0 | 1,09% | 0,011 0 | 0,75% | 0,011 0 | 0,57% |
| Natural materials | 0,008 | 1,00% | 0,008 | 0,79% | 0,008 | 0,55% | 0,009 | 0,45% |
| Paper and cardboard | 0,008 | 1,00% | 0,008 | 0,79% | 0,008 | 0,55% | 0,009 | 0,45% |
| Electrical/electronic | 0,053 | 6,56% | 0,053 | 5,18% | 0,053 | 3,60% | 0,053 | 2,73% |
| Actives | 0,001 | 0,13% | 0,001 | 0,10% | 0,001 | 0,07% | 0,001 | 0,05% |
| Electromechanics | 0,002 | 0,21% | 0,002 | 0,17% | 0,002 | 0,12% | 0,002 | 0,09% |
| Passives | 0,023 | 2,88% | 0,023 | 2,27% | 0,023 | 1,58% | 0,023 | 1,20% |
| Cables | 0,001 | 0,13% | 0,001 | 0,10% | 0,001 | 0,07% | 0,001 | 0,05% |
| Solders | 0,020 | 2,50% | 0,020 | 1,97% | 0,020 | 1,37% | 0,020 | 1,04% |
| PWBs | 0,006 | 0,72% | 0,006 | 0,57% | 0,006 | 0,39% | 0,006 | 0,30% |
| Total material | 0,800 | 100,00 % | 1,013 | 100,00 % | 1,460 | 100,00 % | 1,923 | 100,00 % |
| Packaging material | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % |

Product Description

| | | | | | | | | |
|---------------------------------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|
| Paper and cardboard | 0,140 | 97,22 % | 0,140 | 97,22% | 0,189 | 97,93% | 0,233 | 98,32% |
| PE_Film | 0,004 | 2,78% | 0,004 | 2,78% | 0,004 | 2,07% | 0,004 | 1,68% |
| Total packaging | 0,144 | 100,00 % | 0,144 | 100,00 % | 0,193 | 100,00 % | 0,237 | 100,00 % |
| Total material & packaging | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % |
| Total material | 0,800 | 84,77 % | 1,013 | 87,57% | 1,460 | 88,32% | 1,923 | 89,01% |
| Total packaging | 0,144 | 15,23 % | 0,144 | 12,43% | 0,193 | 11,68% | 0,237 | 10,99% |
| Total material & packaging | 0,944 | 100,00 % | 1,157 | 100,00 % | 1,653 | 100,00 % | 2,160 | 100,00 % |

Table 3: Product composition ABQM 4.0 DN 15 -32

| Material | DN 15 | | DN 20 | | DN 25 | | DN 32 | |
|---------------------------------------|------------------|----------------|------------------|----------------|------------------|----------------|------------------|----------------|
| | Mass (kg) | (%) | Mass (kg) | (%) | Mass (kg) | (%) | Mass (kg) | (%) |
| Metals | 0,499 | 94,71% | 0,709 | 96,11% | 1,133 | 95,54% | 1,576 | 95,54% |
| Stainless steel | 0,010 | 1,90% | 0,010 | 1,08% | 0,071 | 5,95% | 0,108 | 6,55% |
| Brass | 0,489 | 92,81% | 0,701 | 95,02% | 1,063 | 89,60% | 1,468 | 89,00% |
| Plastics & Rubbers | 0,022 | 4,21% | 0,023 | 3,12% | 0,047 | 3,98% | 0,067 | 4,07% |
| ABS | 0,003 | 0,63% | 0,003 | 0,41% | 0,003 | 0,25% | 0,003 | 0,18% |
| EPDM_Ext | 0,002 | 0,39% | 0,003 | 0,42% | 0,005 | 0,42% | 0,005 | 0,31% |
| Iglidur | 0,0002 | 0,04% | 0,0002 | 0,03% | 0,0002 | 0,02% | 0,0002 | 0,01% |
| PP | 0,017 | 3,16% | 0,017 | 2,27% | 0,039 | 3,28% | 0,059 | 3,57% |
| Natural materials | 0,006 | 1,08% | 0,006 | 0,77% | 0,006 | 0,48% | 0,006 | 0,39% |
| Paper and cardboard | 0,006 | 1,08% | 0,006 | 0,77% | 0,006 | 0,48% | 0,006 | 0,39% |
| Total material | 0,526 | 100,00% | 0,738 | 100,00% | 1,186 | 100,00% | 1,649 | 100,00% |
| Packaging material | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % |
| Paper and cardboard | 0,087 | 95,59% | 0,087 | 95,59% | 0,057 | 93,39% | 0,057 | 93,42% |
| PE_Film | 0,004 | 4,41% | 0,004 | 4,41% | 0,004 | 6,61% | 0,004 | 6,58% |
| Total packaging | 0,091 | 100,00% | 0,091 | 100,00% | 0,061 | 100,00% | 0,061 | 100,00% |
| Total material & packaging | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % | Mass (kg) | % |
| Total material | 0,526 | 85,30% | 0,738 | 89,04% | 1,186 | 95,15% | 1,649 | 96,45% |
| Total packaging | 0,091 | 14,70% | 0,091 | 10,96% | 0,061 | 4,85% | 0,061 | 3,55% |
| Total material & packaging | 0,617 | 100,00% | 0,828 | 100,00% | 1,247 | 100,00% | 1,710 | 100,00% |

Product Description

Table 4: Product composition AME 110

| Material | Mass (kg) | (%) |
|---------------------------------------|------------------|----------------|
| Metals | 0,032 | 9,69% |
| Steel (excl. stainless steel) | 0,006 | 1,79% |
| Stainless steel | 0,005 | 1,36% |
| Brass | 0,022 | 6,54% |
| Plastics & Rubbers | 0,250 | 75,78% |
| EPDM_Ext | 0,002 | 0,61% |
| POM | 0,156 | 47,11% |
| PBT_GF | 0,074 | 22,52% |
| PP | 0,001 | 0,22% |
| PVC | 0,017 | 5,15% |
| SBR_Ext | 0,001 | 0,18% |
| Natural materials | 0,004 | 1,14% |
| Paper and cardboard | 0,004 | 1,14% |
| Electrical/electronic | 0,044 | 13,39% |
| Actives | 0,005 | 1,46% |
| Electromechanics | 0,001 | 0,22% |
| Passives | 0,030 | 9,02% |
| PWBs | 0,009 | 2,69% |
| Total material | 0,330 | 100,00% |
| Packaging material | Mass (kg) | % |
| Paper and cardboard | 0,041 | 100,00% |
| Total packaging | 0,041 | 100,00% |
| Total material & packaging | Mass (kg) | % |
| Total material | 0,330 | 88,98% |
| Total packaging | 0,041 | 11,02% |
| Total material & packaging | 0,371 | 100,00% |

Overview of LCA study

Data quality

Data quality of the selected datasets is generally assessed as good and very good in terms of geographical, time and technology representativeness and applicability. Background data is from GaBi database version 2022.

Allocation and cut-off criteria

The allocation is made in accordance with the provisions of EN 15804+A2. All major raw materials and all the essential energy are included. All hazardous materials and substances are considered in the inventory. Data sets within the system boundary are complete and fulfil the criteria for the exclusion of inputs and output criteria.

System boundaries

The results in this EPD are split into life cycle modules following EN 15804 (Figure 1): production (A1-A3), distribution (A4), use (B6) and the end of the product's life (C1-C4). Module D represents environmental benefits and loads that occur beyond the system boundary (i.e., in future products).

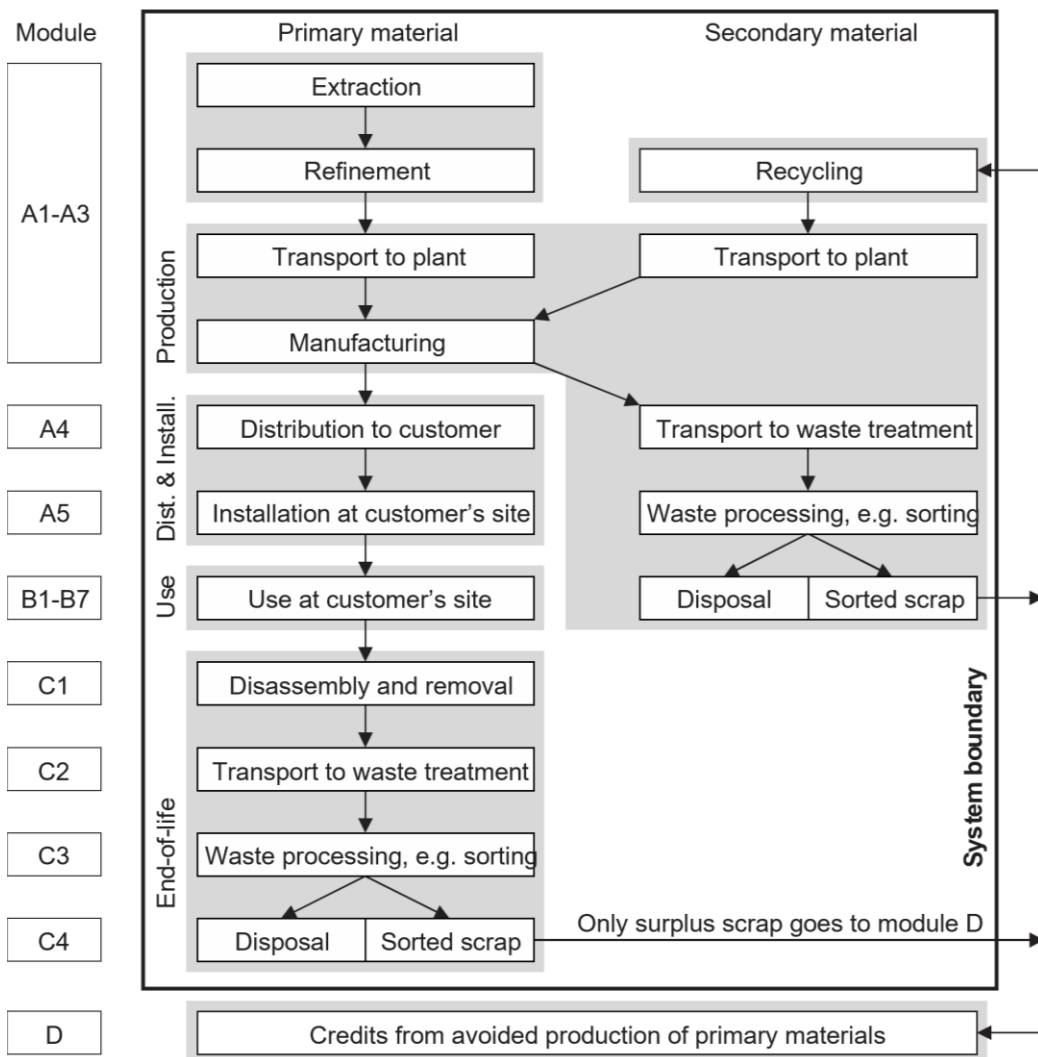


Figure 2: Modular structure used in this EPD (following EN 15804+A2)

Overview of LCA study

Product and packaging manufacture (A1-A3)

Final manufacturing occurs in the Ljubljana plant, China. The facility is certified according to IATF 16949 compliant, ISO 14001, ISO 9001, PED/PESR, UL & MID. Where waste generated on-site is recyclable, it is separated and recycled. For further information, [see here](#). The product is shipped in the packaging as described in Table 3. All packaging materials can be safely recycled or incinerated if appropriate local facilities are available.

Table 5: Biogenic carbon content in product and packaging ABQM 4.0 DN 15 & AME 110

| | Total (excluding recycling) |
|--|-----------------------------|
| Biogenic carbon content in product [kg] | 0,00359 |
| Biogenic carbon content in accompanying packaging [kg] | 0,0629 |

Note: 1 kg biogenic carbon is equivalent to 44/12 kg of CO₂.

Table 6: Biogenic carbon content in product and packaging ABQM 4.0 DN 20 & AME 110

| | Total (excluding recycling) |
|--|-----------------------------|
| Biogenic carbon content in product [kg] | 0,00359 |
| Biogenic carbon content in accompanying packaging [kg] | 0,0629 |

Note: 1 kg biogenic carbon is equivalent to 44/12 kg of CO₂.

Table 7: Biogenic carbon content in product and packaging ABQM 4.0 DN 25 & AME 110

| | Total (excluding recycling) |
|--|-----------------------------|
| Biogenic carbon content in product [kg] | 0,00359 |
| Biogenic carbon content in accompanying packaging [kg] | 0,0851 |

Note: 1 kg biogenic carbon is equivalent to 44/12 kg of CO₂.

Table 8: Biogenic carbon content in product and packaging ABQM 4.0 DN 32 & AME 110

| | Total (excluding recycling) |
|--|-----------------------------|
| Biogenic carbon content in product [kg] | 0,00390 |
| Biogenic carbon content in accompanying packaging [kg] | 0,105 |

Note: 1 kg biogenic carbon is equivalent to 44/12 kg of CO₂.

Shipping and installation (A4-A5)

This ABQM 4.0 with AME 110 actuator is sold in the European union, an average distance of 1151 km by truck it was calculated based on 2021 sales data between the factory and the final customer. It is an average for all 4 dimensions.

Module A5 includes disposal of packaging materials only. The product is assumed to be installed by hand. Energy use in handheld tools during installation is not included as it falls below the cut-off criteria in the Core Rules.

Use phase (B1-B6)

The Reference Service Life (RSL) applied in this EPD is 10 years. The use electricity consumption is size independent, so the use case representative for all 4 dimensions (DN 15, 20, 25 & 32).

Overview of LCA study

Table 9: Use phase data for ABQM 4.0 with AME 110

| Application inputs: Season duration: 0,5 year; Actuator operation time per day: 10 hours | | | |
|---|-------|----------|--------------------------|
| Aspect | Value | Unit | Comment / Source |
| Power consumption "in operation" | 2 | W | Danfoss AME110 datasheet |
| Power consumption "on standby" | 0,5 | W | Danfoss AME110 datasheet |
| % of time actuator is working (moving) | 6 | % | Danfoss team |
| % of time actuator is in standby | 94% | % | Danfoss team |
| Yearly total time "in operation" | 1825 | h/year | Calculated |
| Yearly total time "working" | 110 | h/year | Calculated |
| Yearly total time "on standby" | 1715 | h/year | Calculated |
| AME110 Power consumption STB | 0,86 | kWh/year | Calculated |
| AME110 Power consumption Working | 0,22 | kWh/year | Calculated |
| AME110 Power consumption total | 1,08 | kWh/year | Calculated |

The scope of this study is targeted for the European Union market; therefore, the product under study is sold and used in European Union. Sales also occur outside of European Union, which is important to note considering the impact the electricity grid mix can have on the emissions in the use phase. To represent the EU market for the purpose of this assessment, an average EU-27 CO₂ factor from GaBi database (2022) is applied.

For this reason, 2 alternative scenarios were made to represent the use phase for the USA and China market.

Table 10: CO₂ emissions per use phase location for ABQM 4.0 with AME 110

| Location of use | Use phase, kgCO ₂ eq (GWPF) |
|------------------------------------|--|
| European Union (Baseline scenario) | 4,72E00 |
| China | 8,74E00 |
| USA | 5,55E00 |

The major limitation of the impact calculations for the use phase is that the electricity grid mix in use is assumed to remain at the same carbon intensity over time. Following the plans for the decarbonization of the grid across EU, USA and China, the environmental impacts are expected to decrease over time within the course of the next 10 years. However, as decarbonization will occur in the future and as the pace of decarbonization is uncertain, the use of the emission intensity of today's grid should prove to be a "worst-case", conservative assumption.

End-of-life (C1-C4)

The standard end-of-life procedure from EN 50598-3 has been applied:

- Manual dismantling is used to separate recyclable bulk materials, e.g. bulk metals and plastics.

Overview of LCA study

- Shredding is used for the remaining parts, such as printed circuit board assemblies.
- Ferrous metals, non-ferrous metals and bulk plastics are recovered through recycling.
- The remaining materials go to either energy recovery or landfill.

In line with EN 15804+A2, only the 'net scrap' (i.e., the leftover recyclable materials remaining after inputs of recycled content required in the manufacturing phase are first satisfied) is used to calculate the benefits and loads beyond the system boundary (Module D).

Two scenarios are examined for the end-of-life.

1. Recycling scenario with 100% of the product sent to recycling at the end-of-life, excluding fractions that cannot be recycled or incinerated (e.g., glass reinforcing in glass-filled plastics) and are sent to landfill (C3.1, C4.1, D.1)

This scenario illustrates best case performance. It assumes a 100% collection rate and best available recycling technologies. Under this scenario electrical cables, and all metals, flat glass and unreinforced plastics found within the body and chassis of the product are recycled. Printed circuit board assemblies are incinerated, and the copper and precious metals (gold, silver, palladium, and platinum) are recycled.

2. Landfill scenario with 100% of the product sent to landfill (C3.2, C4.2, D.2).

This scenario assumes that the whole product, including its packaging, is landfilled. It is designed to represent a poor end-of-life-route where valuable resources are lost.

Benefits and loads beyond the system boundary (D)

Module D considers the net benefit of recycling (including energy recovery) of materials in the product and packaging, taking account of losses in the recycling process and the recycled material used in the production of the product. Module D covers the two end-of-life scenarios, as described above.

Environmental performance

This section presents the environmental performance of one-unit ABQM 4.0 valve (DN 15, 20, 25, 32) with AME 110 actuator. Figure 3-6 presents the environmental impact of the ABQM 4.0 valve (DN 15, 20, 25, 32) with AME 110 actuator across a number of environmental impact categories (following EN 15804+A2:2019) per life cycle stage, over its full 10-year life cycle, including Global Warming Potential.

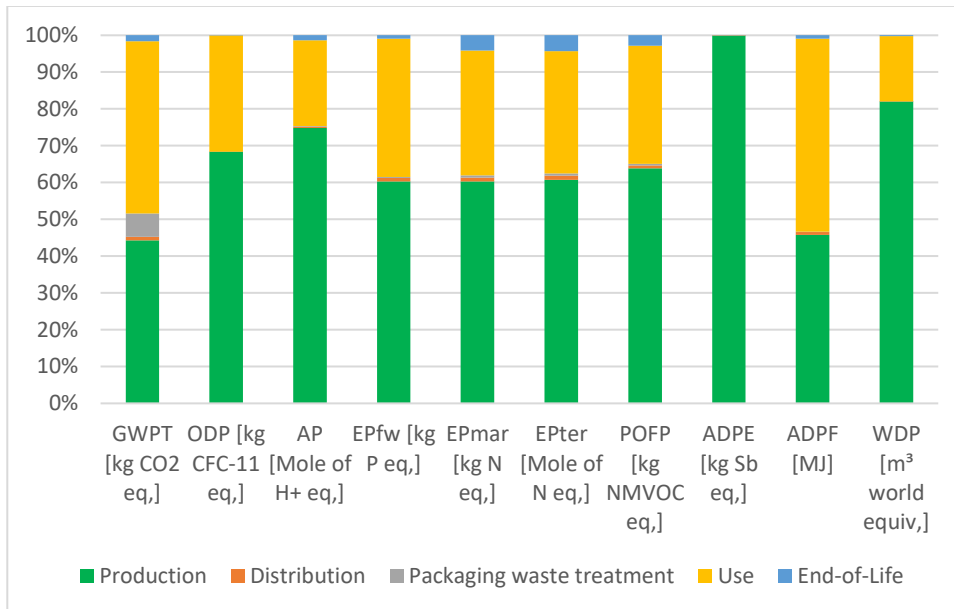


Figure 3: Breakdown of environmental impacts by life cycle stages for ABQM 4.0 DN 15 with AME 110 (see Table 15 for descriptions of environmental impact indicators).

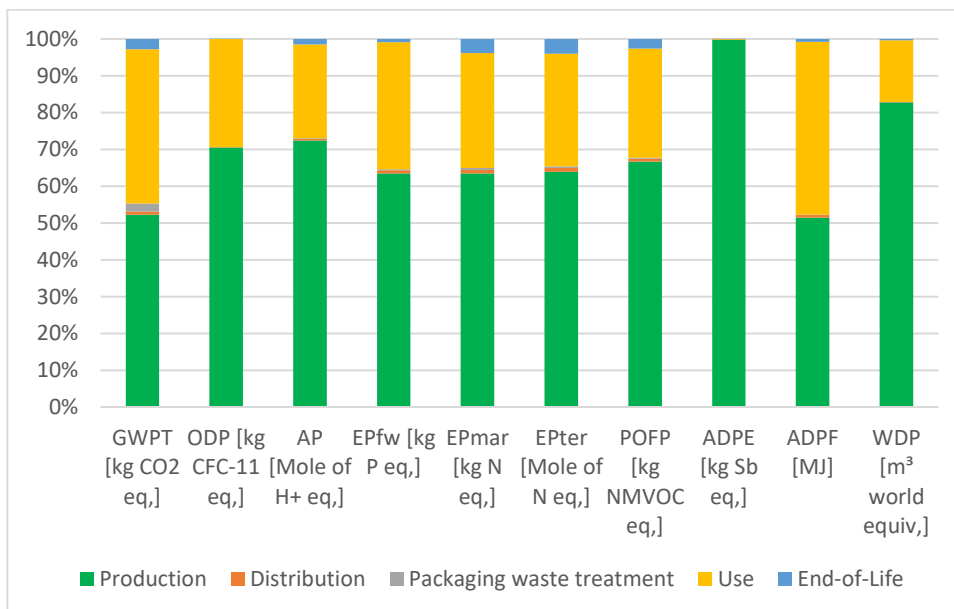


Figure 4: Breakdown of environmental impacts by life cycle stages ABQM 4.0 DN 20 with AME 110 (see Table 15 for descriptions of environmental impact indicators).

Environmental performance

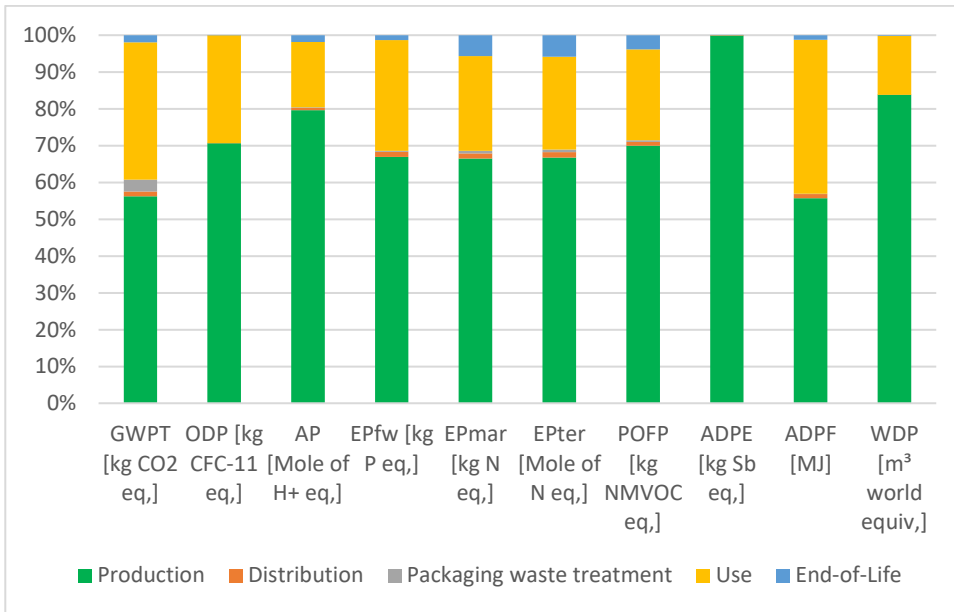


Figure 5: Breakdown of environmental impacts by life cycle stages ABQM 4.0 DN 25 with AME 110 (see Table 15 for descriptions of environmental impact indicators).

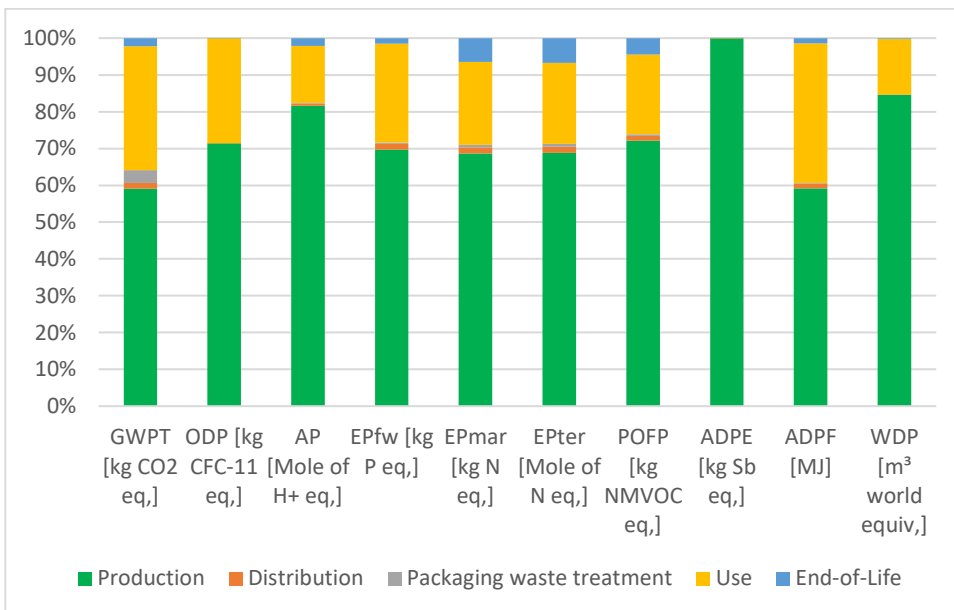


Figure 6: Breakdown of environmental impacts by life cycle stages ABQM 4.0 DN 32 with AME 110 (see Table 15 for descriptions of environmental impact indicators).



Environmental performance

Table 11: Environmental impact indicators ABQM 4.0 DN 15 & AME 110

| | Production | Distribution | Packaging waste treatment | Use | End-of-Life | | | | | | (not included in Figure 4) | |
|--|--|--|--|---|---|---|--------------------------------|---------------|---|---------------|--|--------------|
| Life cycle stages based on EN 15804+A2 | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
| Description | Manufacture of the product from 'cradle-to-gate' | Transport of the product to the customer | Installation of the product and disposal of used packaging | Use of the product over its lifetime e.g., 10 years | Deinstallation of the product from the site | Transport of the product to waste treatment | Processing waste for recycling | | Disposal of waste that cannot be recycled (through landfill and incineration) | | Potential benefits and loads beyond the system boundary due to reuse, recycling, and energy recovery | |
| Environmental Impact Indicators | | | | | | | | | | | | |
| GWPT [kg CO2 eq.] | 3,79E+00 | 7,93E-02 | 3,75E-01 | 3,86E+00 | N/A | 7,25E-03 | 7,48E-02 | N/A | 4,80E-02 | 2,42E-02 | -4,15E-01 | 2,04E-01 |
| GWPF [kg CO2 eq.] | 4,15E+00 | 7,88E-02 | 1,26E-02 | 3,82E+00 | N/A | 7,25E-03 | 7,43E-02 | N/A | 4,80E-02 | 2,42E-02 | -4,15E-01 | 2,04E-01 |
| GWPB [kg CO2 eq.] | -3,63E-01 | 0,00E+00 | 3,63E-01 | 3,44E-02 | N/A | 0,00E+00 | 0,00E+00 | N/A | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| GWPLULUC [kg CO2 eq.] | 3,78E-03 | 5,39E-04 | 8,57E-06 | 8,10E-04 | N/A | 1,72E-07 | 4,64E-04 | N/A | 3,36E-07 | 2,28E-05 | -4,11E-04 | 4,46E-04 |
| ODP [kg CFC-11 eq.] | 1,21E-10 | 7,86E-15 | 9,46E-16 | 5,59E-11 | N/A | 8,31E-19 | 9,75E-14 | N/A | 1,45E-14 | 3,34E-14 | -1,67E-11 | 1,85E-12 |
| AP [Mole of H+ eq.] | 2,68E-02 | 1,44E-04 | 7,03E-05 | 8,35E-03 | N/A | 1,08E-05 | 4,29E-04 | N/A | 3,52E-05 | 1,38E-04 | -8,56E-03 | 3,92E-03 |
| EPfw [kg P eq.] | 1,80E-05 | 2,86E-07 | 7,99E-08 | 1,12E-05 | N/A | 1,54E-09 | 2,63E-07 | N/A | 6,64E-09 | 1,15E-06 | -4,85E-07 | 1,14E-06 |
| EPmar [kg N eq.] | 3,34E-03 | 5,72E-05 | 3,58E-05 | 1,88E-03 | N/A | 4,38E-06 | 2,06E-04 | N/A | 1,75E-05 | 4,61E-05 | -2,76E-04 | 2,40E-04 |
| EPter [Mole of N eq.] | 3,60E-02 | 6,57E-04 | 3,92E-04 | 1,97E-02 | N/A | 4,84E-05 | 2,28E-03 | N/A | 1,99E-04 | 4,97E-04 | -2,97E-03 | 2,55E-03 |
| POFP [kg NMVOC eq.] | 1,01E-02 | 1,27E-04 | 6,66E-05 | 5,07E-03 | N/A | 1,02E-05 | 3,92E-04 | N/A | 4,41E-05 | 1,17E-04 | -1,36E-03 | 7,44E-04 |
| ADPE [kg Sb eq.] | 9,54E-04 | 8,06E-09 | 4,07E-09 | 1,04E-06 | N/A | 2,53E-10 | 8,61E-09 | N/A | 2,51E-10 | 1,78E-09 | -1,20E-04 | 4,04E-04 |
| ADPF [MJ] | 6,03E+01 | 1,05E+00 | 1,64E-01 | 6,91E+01 | N/A | 1,03E-01 | 1,01E+00 | N/A | 4,06E-02 | 3,31E-01 | -1,00E+01 | 3,84E-01 |
| WDP [m ³ world equiv.] | 3,97E+00 | 8,95E-04 | 9,60E-04 | 8,58E-01 | N/A | 1,20E-05 | 2,16E-03 | N/A | 9,36E-03 | 1,16E-03 | -7,82E-02 | 1,30E-01 |

Table 12: Environmental impact indicators ABQM 4.0 DN 20 & AME 110

| | Production | Distribution | Packaging waste treatment | Use | End-of-Life | | | | | | (not included in Figure 4) | |
|--|--|--|--|---|---|---|--------------------------------|---------------|---|---------------|--|--------------|
| Life cycle stages based on EN 15804+A2 | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
| Description | Manufacture of the product from 'cradle-to-gate' | Transport of the product to the customer | Installation of the product and disposal of used packaging | Use of the product over its lifetime e.g., 10 years | Deinstallation of the product from the site | Transport of the product to waste treatment | Processing waste for recycling | | Disposal of waste that cannot be recycled (through landfill and incineration) | | Potential benefits and loads beyond the system boundary due to reuse, recycling, and energy recovery | |
| Environmental Impact Indicators | | | | | | | | | | | | |
| GWPT [kg CO2 eq.] | 4,29E+00 | 9,73E-02 | 2,48E-01 | 3,86E+00 | N/A | 9,18E-03 | 9,45E-02 | N/A | 5,05E-02 | 2,94E-02 | -4,37E-01 | 2,80E-01 |
| GWPF [kg CO2 eq.] | 4,52E+00 | 9,66E-02 | 1,26E-02 | 3,82E+00 | N/A | 9,18E-03 | 9,39E-02 | N/A | 5,05E-02 | 2,94E-02 | -4,37E-01 | 2,79E-01 |
| GWPB [kg CO2 eq.] | -2,35E-01 | 0,00E+00 | 2,35E-01 | 3,44E-02 | N/A | 0,00E+00 | 0,00E+00 | N/A | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| GWPLULUC [kg CO2 eq.] | 4,36E-03 | 6,61E-04 | 8,57E-06 | 8,10E-04 | N/A | 2,18E-07 | 5,97E-04 | N/A | 3,46E-07 | 2,87E-05 | -4,26E-04 | 5,98E-04 |
| ODP [kg CFC-11 eq.] | 1,22E-10 | 9,63E-15 | 9,46E-16 | 5,59E-11 | N/A | 1,05E-18 | 9,91E-14 | N/A | 1,46E-14 | 4,09E-14 | -1,59E-11 | 2,63E-12 |
| AP [Mole of H+ eq.] | 2,93E-02 | 1,76E-04 | 7,03E-05 | 8,35E-03 | N/A | 1,36E-05 | 5,49E-04 | N/A | 3,54E-05 | 1,72E-04 | -8,71E-03 | 5,26E-03 |
| EPfw [kg P eq.] | 1,93E-05 | 3,50E-07 | 7,99E-08 | 1,12E-05 | N/A | 1,95E-09 | 3,34E-07 | N/A | 6,68E-09 | 1,16E-06 | -5,04E-07 | 1,52E-06 |
| EPmar [kg N eq.] | 3,67E-03 | 7,01E-05 | 3,58E-05 | 1,88E-03 | N/A | 5,55E-06 | 2,64E-04 | N/A | 1,76E-05 | 5,75E-05 | -2,92E-04 | 3,24E-04 |
| EPter [Mole of N eq.] | 3,95E-02 | 8,06E-04 | 3,92E-04 | 1,97E-02 | N/A | 6,13E-05 | 2,93E-03 | N/A | 2,00E-04 | 6,23E-04 | -3,14E-03 | 3,44E-03 |
| POFP [kg NMVOC eq.] | 1,11E-02 | 1,56E-04 | 6,66E-05 | 5,07E-03 | N/A | 1,29E-05 | 5,03E-04 | N/A | 4,42E-05 | 1,46E-04 | -1,43E-03 | 1,01E-03 |
| ADPE [kg Sb eq.] | 1,14E-03 | 9,88E-09 | 4,07E-09 | 1,04E-06 | N/A | 3,21E-10 | 1,06E-08 | N/A | 2,55E-10 | 2,17E-09 | -1,37E-04 | 5,41E-04 |
| ADPF [MJ] | 6,59E+01 | 1,29E+00 | 1,64E-01 | 6,91E+01 | N/A | 1,30E-01 | 1,27E+00 | N/A | 4,10E-02 | 4,01E-01 | -1,07E+01 | 8,59E-01 |
| WDP [m ³ world equiv.] | 4,09E+00 | 1,10E-03 | 9,60E-04 | 8,58E-01 | N/A | 1,52E-05 | 2,38E-03 | N/A | 9,56E-03 | 1,51E-03 | -8,44E-02 | 1,75E-01 |

Table 13: Environmental impact indicators ABQM 4.0 DN 25 & AME 110

| | Production | Distribution | Packaging waste treatment | Use | End-of-Life | | | | | | (not included in Figure 4) | |
|--|--|--|--|---|---|---|--------------------------------|---------------|---|---------------|--|--------------|
| Life cycle stages based on EN 15804+A2 | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
| Description | Manufacture of the product from 'cradle-to-gate' | Transport of the product to the customer | Installation of the product and disposal of used packaging | Use of the product over its lifetime e.g., 10 years | Deinstallation of the product from the site | Transport of the product to waste treatment | Processing waste for recycling | | Disposal of waste that cannot be recycled (through landfill and incineration) | | Potential benefits and loads beyond the system boundary due to reuse, recycling, and energy recovery | |
| Environmental Impact Indicators | | | | | | | | | | | | |
| GWPT [kg CO2 eq.] | 5,82E+00 | 1,39E-01 | 3,28E-01 | 3,86E+00 | N/A | 1,32E-02 | 1,36E-01 | N/A | 5,53E-02 | 4,14E-02 | -8,17E-01 | 4,37E-01 |
| GWPF [kg CO2 eq.] | 6,12E+00 | 1,38E-01 | 1,69E-02 | 3,82E+00 | N/A | 1,32E-02 | 1,35E-01 | N/A | 5,53E-02 | 4,14E-02 | -8,16E-01 | 4,36E-01 |
| GWPB [kg CO2 eq.] | -3,11E-01 | 0,00E+00 | 3,11E-01 | 3,44E-02 | N/A | 0,00E+00 | 0,00E+00 | N/A | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| GWPLULUC [kg CO2 eq.] | 5,62E-03 | 9,44E-04 | 1,15E-05 | 8,10E-04 | N/A | 3,14E-07 | 8,76E-04 | N/A | 3,63E-07 | 4,13E-05 | -1,37E-03 | 8,65E-04 |
| ODP [kg CFC-11 eq.] | 1,35E-10 | 1,38E-14 | 1,27E-15 | 5,59E-11 | N/A | 1,52E-18 | 1,03E-13 | N/A | 1,48E-14 | 5,80E-14 | -1,62E-11 | 3,80E-12 |
| AP [Mole of H+ eq.] | 3,74E-02 | 2,52E-04 | 9,43E-05 | 8,35E-03 | N/A | 1,96E-05 | 8,00E-04 | N/A | 3,58E-05 | 2,46E-04 | -1,10E-02 | 7,61E-03 |
| EPfw [kg P eq.] | 2,49E-05 | 5,01E-07 | 1,07E-07 | 1,12E-05 | N/A | 2,81E-09 | 4,82E-07 | N/A | 6,79E-09 | 1,49E-06 | -9,73E-07 | 2,18E-06 |
| EPmar [kg N eq.] | 4,85E-03 | 1,00E-04 | 4,81E-05 | 1,88E-03 | N/A | 8,00E-06 | 3,86E-04 | N/A | 1,77E-05 | 8,20E-05 | -6,16E-04 | 4,84E-04 |
| EPter [Mole of N eq.] | 5,21E-02 | 1,15E-03 | 5,27E-04 | 1,97E-02 | N/A | 8,83E-05 | 4,28E-03 | N/A | 2,02E-04 | 8,92E-04 | -6,64E-03 | 5,15E-03 |
| POFP [kg NMVOC eq.] | 1,44E-02 | 2,23E-04 | 8,94E-05 | 5,07E-03 | N/A | 1,86E-05 | 7,35E-04 | N/A | 4,45E-05 | 2,07E-04 | -2,45E-03 | 1,51E-03 |
| ADPE [kg Sb eq.] | 1,47E-03 | 1,41E-08 | 5,47E-09 | 1,04E-06 | N/A | 4,62E-10 | 1,48E-08 | N/A | 2,61E-10 | 3,08E-09 | -1,64E-04 | 7,73E-04 |
| ADPF [MJ] | 9,20E+01 | 1,84E+00 | 2,20E-01 | 6,91E+01 | N/A | 1,87E-01 | 1,82E+00 | N/A | 4,19E-02 | 5,66E-01 | -1,74E+01 | 1,54E+00 |
| WDP [m ³ world equiv.] | 4,51E+00 | 1,57E-03 | 1,29E-03 | 8,58E-01 | N/A | 2,19E-05 | 2,83E-03 | N/A | 9,95E-03 | 2,20E-03 | -2,38E-01 | 2,49E-01 |

Table 14: Environmental impact indicators ABQM 4.0 DN 32 & AME 110

| | Production | Distribution | Packaging waste treatment | Use | End-of-Life | | | | | | (not included in Figure 4) | |
|--|--|--|--|---|---|---|--------------------------------|---------------|---|---------------|--|--------------|
| Life cycle stages based on EN 15804+A2 | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
| Description | Manufacture of the product from 'cradle-to-gate' | Transport of the product to the customer | Installation of the product and disposal of used packaging | Use of the product over its lifetime e.g., 10 years | Deinstallation of the product from the site | Transport of the product to waste treatment | Processing waste for recycling | | Disposal of waste that cannot be recycled (through landfill and incineration) | | Potential benefits and loads beyond the system boundary due to reuse, recycling, and energy recovery | |
| Environmental Impact Indicators | | | | | | | | | | | | |
| GWPT [kg CO2 eq.] | 6,77E+00 | 1,81E-01 | 4,02E-01 | 3,86E+00 | N/A | 1,74E-02 | 1,79E-01 | N/A | 5,53E-02 | 5,38E-02 | -1,08E+00 | 5,97E-01 |
| GWPF [kg CO2 eq.] | 7,14E+00 | 1,80E-01 | 2,07E-02 | 3,82E+00 | N/A | 1,74E-02 | 1,78E-01 | N/A | 5,53E-02 | 5,37E-02 | -1,08E+00 | 5,96E-01 |
| GWPB [kg CO2 eq.] | -3,82E-01 | 0,00E+00 | 3,82E-01 | 3,44E-02 | N/A | 0,00E+00 | 0,00E+00 | N/A | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| GWPLULUC [kg CO2 eq.] | 6,85E-03 | 1,23E-03 | 1,42E-05 | 8,10E-04 | N/A | 4,13E-07 | 1,17E-03 | N/A | 3,63E-07 | 5,43E-05 | -1,97E-03 | 1,16E-03 |
| ODP [kg CFC-11 eq.] | 1,40E-10 | 1,80E-14 | 1,56E-15 | 5,59E-11 | N/A | 2,00E-18 | 1,07E-13 | N/A | 1,48E-14 | 7,55E-14 | -1,64E-11 | 5,16E-12 |
| AP [Mole of H+ eq.] | 4,39E-02 | 3,29E-04 | 1,16E-04 | 8,35E-03 | N/A | 2,58E-05 | 1,06E-03 | N/A | 3,58E-05 | 3,22E-04 | -1,27E-02 | 1,02E-02 |
| EPfw [kg P eq.] | 2,91E-05 | 6,54E-07 | 1,32E-07 | 1,12E-05 | N/A | 3,70E-09 | 6,35E-07 | N/A | 6,77E-09 | 1,77E-06 | -1,26E-06 | 2,92E-06 |
| EPmar [kg N eq.] | 5,73E-03 | 1,31E-04 | 5,92E-05 | 1,88E-03 | N/A | 1,05E-05 | 5,13E-04 | N/A | 1,76E-05 | 1,07E-04 | -8,32E-04 | 6,53E-04 |
| EPter [Mole of N eq.] | 6,15E-02 | 1,50E-03 | 6,48E-04 | 1,97E-02 | N/A | 1,16E-04 | 5,69E-03 | N/A | 2,01E-04 | 1,17E-03 | -8,98E-03 | 6,96E-03 |
| POFP [kg NMVOC eq.] | 1,69E-02 | 2,91E-04 | 1,10E-04 | 5,07E-03 | N/A | 2,45E-05 | 9,76E-04 | N/A | 4,44E-05 | 2,70E-04 | -3,15E-03 | 2,05E-03 |
| ADPE [kg Sb eq.] | 1,83E-03 | 1,85E-08 | 6,73E-09 | 1,04E-06 | N/A | 6,09E-10 | 1,91E-08 | N/A | 2,61E-10 | 4,01E-09 | -1,95E-04 | 1,03E-03 |
| ADPF [MJ] | 1,08E+02 | 2,40E+00 | 2,71E-01 | 6,91E+01 | N/A | 2,47E-01 | 2,38E+00 | N/A | 4,18E-02 | 7,33E-01 | -2,25E+01 | 2,29E+00 |
| WDP [m ³ world equiv.] | 4,80E+00 | 2,05E-03 | 1,59E-03 | 8,58E-01 | N/A | 2,89E-05 | 3,31E-03 | N/A | 9,93E-03 | 2,92E-03 | -3,37E-01 | 3,33E-01 |

How to read scientific numbers:

e.g. 2,05E02 = 2,05 x 10² = 205

2,04E-01 = 2,04 x 10⁻¹ = 0,204

Table 15: Environmental impact indicator descriptions

| Acronym | Unit | Indicator |
|----------|--------------------------|--|
| GWPT | kg CO ₂ eq. | Carbon footprint (Global Warming Potential) – total |
| GWPF | kg CO ₂ eq. | Carbon footprint (Global Warming Potential) – fossil |
| GWPB | kg CO ₂ eq. | Carbon footprint (Global Warming Potential) – biogenic |
| GWPLULUC | kg CO ₂ eq. | Carbon footprint (Global Warming Potential) – land use and land use change |
| ODP | kg CFC-11 eq. | Depletion potential of the stratospheric ozone layer |
| AP | Mole H+ eq. | Acidification potential |
| EPfw | kg P eq. | Eutrophication potential – aquatic freshwater |
| EPmar | kg N eq. | Eutrophication potential – aquatic marine |
| EPter | Mole of N eq. | Eutrophication potential – terrestrial |
| POFP | kg NMVOC eq. | Summer smog (photochemical ozone formation potential) |
| ADPE* | kg Sb eq. | Depletion of abiotic resources – minerals and metals |
| ADPF* | MJ | Depletion of abiotic resources – fossil fuels |
| WDP* | m ³ world eq. | Water deprivation potential (deprivation-weighted water consumption) |

Results for module A1-A3 are specific to the product. All results from module A4 onwards should be considered as scenarios that represent one possible outcome. The true environmental performance of the product will depend on actual use.

The results in this section are relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks. EPDs from others may not be comparable.

Carbon footprint

The total carbon footprint (GWPF), cradle-to-grave, of the product is from 8,19E00 (DN 15) to 1,14E01 kg CO₂-eq (DN 32) for A1-C4, based on the average use phase scenario. The carbon footprint (GWPF) of production of this product, cradle-to-gate, is from 4,15E00 kg CO₂-eq (DN 15) to 7,14E00 kg CO₂-eq (DN32) for A1-A3.

Table 16: Resource use ABQM 4.0 DN 15 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PERE [MJ] | 2,54E+01 | 7,28E-02 | 7,26E-03 | 3,84E+01 | N/A | 3,38E-04 | 1,25E-01 | N/A | 7,90E-03 | 2,85E-02 | -8,55E-01 | 1,36E+00 |
| PERM [MJ] | 1,20E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PERT [MJ] | 2,55E+01 | 7,28E-02 | 7,26E-03 | 3,84E+01 | N/A | 3,38E-04 | 1,25E-01 | N/A | 7,90E-03 | 2,85E-02 | -8,55E-01 | 1,36E+00 |
| PENRE [MJ] | 5,75E+01 | 1,05E+00 | 1,76E-01 | 6,91E+01 | N/A | 1,03E-01 | 1,02E+00 | N/A | 4,06E-02 | 3,32E-01 | -1,00E+01 | 3,84E-01 |
| PENRM [MJ] | 2,80E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PENRT [MJ] | 6,03E+01 | 1,05E+00 | 1,76E-01 | 6,91E+01 | N/A | 1,03E-01 | 1,02E+00 | N/A | 4,06E-02 | 3,32E-01 | -1,00E+01 | 3,84E-01 |
| SM [kg] | 4,74E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| RSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| NRSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| FW [m3] | 9,80E-02 | 8,41E-05 | 3,09E-05 | 3,64E-02 | N/A | 5,44E-07 | 1,31E-04 | N/A | 2,20E-04 | 3,82E-05 | -2,67E-03 | 1,27E-03 |

Table 17: Resource use ABQM 4.0 DN 20 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PERE [MJ] | 2,72E+01 | 8,92E-02 | 7,26E-03 | 3,84E+01 | N/A | 4,28E-04 | 1,42E-01 | N/A | 7,97E-03 | 3,49E-02 | -9,06E-01 | 1,82E+00 |
| PERM [MJ] | 1,20E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PERT [MJ] | 2,73E+01 | 8,92E-02 | 7,26E-03 | 3,84E+01 | N/A | 4,28E-04 | 1,42E-01 | N/A | 7,97E-03 | 3,49E-02 | -9,06E-01 | 1,82E+00 |
| PENRE [MJ] | 6,31E+01 | 1,29E+00 | 1,76E-01 | 6,91E+01 | N/A | 1,30E-01 | 1,28E+00 | N/A | 4,10E-02 | 4,02E-01 | -1,07E+01 | 8,59E-01 |
| PENRM [MJ] | 2,82E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PENRT [MJ] | 6,59E+01 | 1,29E+00 | 1,76E-01 | 6,91E+01 | N/A | 1,30E-01 | 1,28E+00 | N/A | 4,10E-02 | 4,02E-01 | -1,07E+01 | 8,59E-01 |
| SM [kg] | 6,05E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| RSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| NRSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| FW [m3] | 1,01E-01 | 1,03E-04 | 3,09E-05 | 3,64E-02 | N/A | 6,88E-07 | 1,52E-04 | N/A | 2,25E-04 | 4,89E-05 | -2,77E-03 | 1,73E-03 |

Table 18: Resource use ABQM 4.0 DN 25 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PERE [MJ] | 3,76E+01 | 1,27E-01 | 9,74E-03 | 3,84E+01 | N/A | 6,17E-04 | 1,80E-01 | N/A | 8,12E-03 | 4,95E-02 | -1,83E+00 | 2,56E+00 |
| PERM [MJ] | 1,20E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PERT [MJ] | 3,77E+01 | 1,27E-01 | 9,74E-03 | 3,84E+01 | N/A | 6,17E-04 | 1,80E-01 | N/A | 8,12E-03 | 4,95E-02 | -1,83E+00 | 2,56E+00 |
| PENRE [MJ] | 8,83E+01 | 1,85E+00 | 2,36E-01 | 6,91E+01 | N/A | 1,88E-01 | 1,82E+00 | N/A | 4,18E-02 | 5,66E-01 | -1,74E+01 | 1,54E+00 |
| PENRM [MJ] | 3,83E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PENRT [MJ] | 9,21E+01 | 1,85E+00 | 2,36E-01 | 6,91E+01 | N/A | 1,88E-01 | 1,82E+00 | N/A | 4,18E-02 | 5,66E-01 | -1,74E+01 | 1,54E+00 |
| SM [kg] | 8,59E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| RSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| NRSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| FW [m3] | 1,13E-01 | 1,47E-04 | 4,14E-05 | 3,64E-02 | N/A | 9,92E-07 | 1,95E-04 | N/A | 2,34E-04 | 7,05E-05 | -8,80E-03 | 2,51E-03 |

Table 19: Resource use ABQM 4.0 DN 32 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PERE [MJ] | 4,30E+01 | 1,67E-01 | 1,20E-02 | 3,84E+01 | N/A | 8,13E-04 | 2,19E-01 | N/A | 8,11E-03 | 6,44E-02 | -2,43E+00 | 3,42E+00 |
| PERM [MJ] | 1,30E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PERT [MJ] | 4,31E+01 | 1,67E-01 | 1,20E-02 | 3,84E+01 | N/A | 8,13E-04 | 2,19E-01 | N/A | 8,11E-03 | 6,44E-02 | -2,43E+00 | 3,42E+00 |
| PENRE [MJ] | 1,03E+02 | 2,41E+00 | 2,91E-01 | 6,91E+01 | N/A | 2,47E-01 | 2,39E+00 | N/A | 4,18E-02 | 7,33E-01 | -2,25E+01 | 2,30E+00 |
| PENRM [MJ] | 4,69E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| PENRT [MJ] | 1,08E+02 | 2,41E+00 | 2,91E-01 | 6,91E+01 | N/A | 2,47E-01 | 2,39E+00 | N/A | 4,18E-02 | 7,33E-01 | -2,25E+01 | 2,30E+00 |
| SM [kg] | 1,14E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| RSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| NRSF [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| FW [m3] | 1,21E-01 | 1,92E-04 | 5,10E-05 | 3,64E-02 | N/A | 1,31E-06 | 2,40E-04 | N/A | 2,33E-04 | 9,31E-05 | -1,26E-02 | 3,37E-03 |

Table 20: Resource use indicator descriptions

| Acronym | Unit | Indicator |
|----------------|----------------|---|
| PERE | MJ | Use of renewable primary energy excluding renewable primary energy resources used as raw materials |
| PERM | MJ | Use of renewable primary energy resources used as raw materials |
| PERT | MJ | Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) |
| PENRE | MJ | Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials |
| PENRM | MJ | Use of non-renewable primary energy resources used as raw materials |
| PENRT | MJ | Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) |
| SM | kg | Use of secondary material |
| RSF | MJ | Use of renewable secondary fuels |
| NRSF | MJ | Use of non-renewable secondary fuels |
| FW | m ³ | Net use of fresh water |

Table 21: Waste categories and output flows ABQM 4.0 DN 15 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-----------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| HWD [kg] | 8,32E-07 | 5,58E-12 | 7,26E-13 | 5,98E-09 | N/A | 7,06E-13 | 1,45E-11 | N/A | 3,49E-12 | 2,16E-11 | -6,61E-06 | -2,60E-09 |
| NHWD [kg] | 2,17E-01 | 1,72E-04 | 1,63E-05 | 5,22E-02 | N/A | 1,03E-05 | 2,32E-04 | N/A | 1,36E-02 | 7,98E-01 | 1,45E-02 | 2,07E-02 |
| RWD [kg] | 2,72E-03 | 1,96E-06 | 4,16E-07 | 1,10E-02 | N/A | 1,10E-07 | 1,96E-05 | N/A | 1,59E-06 | 2,76E-06 | -5,10E-05 | 1,73E-04 |
| CRU [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| MFR [kg] | 3,15E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 7,37E-01 | N/A | N/A | N/A |
| MER [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| EEE [MJ] | 4,02E-04 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 9,72E-02 | N/A | N/A | N/A |
| EET [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,82E-01 | N/A | N/A | N/A |

Table 22: Waste categories and output flows ABQM 4.0 DN 20 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-----------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| HWD [kg] | 8,32E-07 | 6,84E-12 | 7,26E-13 | 5,98E-09 | N/A | 8,95E-13 | 1,58E-11 | N/A | 3,52E-12 | 2,40E-11 | -6,58E-06 | -2,37E-09 |
| NHWD [kg] | 2,53E-01 | 2,11E-04 | 1,63E-05 | 5,22E-02 | N/A | 1,30E-05 | 2,74E-04 | N/A | 1,36E-02 | 1,01E+00 | 1,51E-02 | 2,70E-02 |
| RWD [kg] | 2,97E-03 | 2,40E-06 | 4,16E-07 | 1,10E-02 | N/A | 1,39E-07 | 2,00E-05 | N/A | 1,61E-06 | 3,26E-06 | -5,54E-05 | 2,30E-04 |
| CRU [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| MFR [kg] | 4,21E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 9,50E-01 | N/A | N/A | N/A |
| MER [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| EEE [MJ] | 4,70E-04 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,01E-01 | N/A | N/A | N/A |
| EET [MJ] | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,89E-01 | N/A | N/A | N/A |

Table 23: Waste categories and output flows ABQM 4.0 DN 25 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-----------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| HWD [kg] | 8,63E-07 | 9,77E-12 | 9,74E-13 | 5,98E-09 | N/A | 1,29E-12 | 1,87E-11 | N/A | 3,57E-12 | 3,24E-11 | -4,51E-05 | -2,42E-09 |
| NHWD [kg] | 3,59E-01 | 3,01E-04 | 2,19E-05 | 5,22E-02 | N/A | 1,88E-05 | 3,63E-04 | N/A | 1,37E-02 | 1,46E+00 | 2,39E-02 | 3,90E-02 |
| RWD [kg] | 5,01E-03 | 3,43E-06 | 5,59E-07 | 1,10E-02 | N/A | 2,01E-07 | 2,09E-05 | N/A | 1,65E-06 | 4,54E-06 | -8,71E-05 | 3,24E-04 |
| CRU [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| MFR [kg] | 6,02E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,39E+00 | N/A | N/A | N/A |
| MER [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| EEE [MJ] | 5,94E-04 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,08E-01 | N/A | N/A | N/A |
| EET [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2,02E-01 | N/A | N/A | N/A |

Table 24: Waste categories and output flows ABQM 4.0 DN 32 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-----------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| HWD [kg] | 8,92E-07 | 1,28E-11 | 1,20E-12 | 5,98E-09 | N/A | 1,70E-12 | 2,17E-11 | N/A | 3,56E-12 | 4,04E-11 | -6,88E-05 | -2,46E-09 |
| NHWD [kg] | 4,51E-01 | 3,93E-04 | 2,70E-05 | 5,22E-02 | N/A | 2,47E-05 | 4,55E-04 | N/A | 1,37E-02 | 1,92E+00 | 3,08E-02 | 5,19E-02 |
| RWD [kg] | 5,64E-03 | 4,48E-06 | 6,88E-07 | 1,10E-02 | N/A | 2,64E-07 | 2,19E-05 | N/A | 1,64E-06 | 5,82E-06 | -1,06E-04 | 4,32E-04 |
| CRU [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| MFR [kg] | 8,04E-01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,86E+00 | N/A | N/A | N/A |
| MER [kg] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| EEE [MJ] | 5,97E-04 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,08E-01 | N/A | N/A | N/A |
| EET [MJ] | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2,02E-01 | N/A | N/A | N/A |

Table 25: Waste category and output flow descriptions

| Acronym | Unit | Indicator |
|----------------|-------------|-------------------------------|
| HWD | kg | Hazardous waste disposed |
| NHWD | kg | Non-hazardous waste disposed |
| RWD | kg | Radioactive waste disposed |
| CRU | kg | Components for reuse |
| MFR | kg | Materials for recycling |
| MER | kg | Materials for energy recovery |
| EEE | kg | Exported energy (electrical) |
| EET | kg | Exported energy (thermal) |

Table 26: Additional indicators* ABQM 4.0 DN 15 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-------------------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PM [Disease incidences] | 2,53E-07 | 9,13E-10 | 4,06E-10 | 6,92E-08 | N/A | 5,73E-11 | 2,59E-09 | N/A | 3,16E-10 | 1,36E-09 | -6,12E-08 | 3,00E-08 |
| IRP [kBq U235 eq.] | 3,73E-01 | 2,96E-04 | 3,53E-05 | 1,86E+00 | N/A | 1,56E-05 | 3,28E-03 | N/A | 2,42E-04 | 3,50E-04 | -1,39E-03 | 7,40E-03 |
| ETPfw [CTUe] | 4,06E+01 | 7,44E-01 | 1,32E-01 | 3,02E+01 | N/A | 7,44E-02 | 6,88E-01 | N/A | 3,13E-02 | 2,46E+00 | -9,04E+00 | 2,52E+00 |
| HTPc [CTUh] | 2,61E-08 | 1,53E-11 | 2,12E-12 | 8,69E-10 | N/A | 1,38E-12 | 1,46E-11 | N/A | 2,49E-12 | 1,72E-11 | -1,14E-09 | 1,33E-10 |
| HTPnc [CTUh] | 1,07E-07 | 8,56E-10 | 8,80E-11 | 3,18E-08 | N/A | 6,00E-11 | 8,62E-10 | N/A | 1,69E-10 | 1,73E-09 | -2,10E-08 | 1,83E-08 |
| SQP [Pt] | 4,30E+01 | 4,45E-01 | 3,72E-02 | 2,50E+01 | N/A | 2,63E-04 | 4,22E-01 | N/A | 8,74E-03 | 3,56E-02 | -1,01E+00 | 2,68E+00 |

Table 27: Additional indicators* ABQM 4.0 DN 20 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-------------------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PM [Disease incidences] | 2,74E-07 | 1,12E-09 | 4,06E-10 | 6,92E-08 | N/A | 7,26E-11 | 3,31E-09 | N/A | 3,18E-10 | 1,71E-09 | -6,24E-08 | 4,01E-08 |
| IRP [kBq U235 eq.] | 4,04E-01 | 3,62E-04 | 3,53E-05 | 1,86E+00 | N/A | 1,97E-05 | 3,34E-03 | N/A | 2,45E-04 | 4,07E-04 | -1,24E-03 | 9,63E-03 |
| ETPfw [CTUe] | 4,41E+01 | 9,12E-01 | 1,32E-01 | 3,02E+01 | N/A | 9,42E-02 | 8,71E-01 | N/A | 3,15E-02 | 3,24E+00 | -9,49E+00 | 3,60E+00 |
| HTPc [CTUh] | 2,63E-08 | 1,88E-11 | 2,12E-12 | 8,69E-10 | N/A | 1,75E-12 | 1,84E-11 | N/A | 2,49E-12 | 2,11E-11 | -1,14E-09 | 1,80E-10 |
| HTPnc [CTUh] | 1,19E-07 | 1,05E-09 | 8,80E-11 | 3,18E-08 | N/A | 7,60E-11 | 1,10E-09 | N/A | 1,69E-10 | 2,14E-09 | -2,20E-08 | 2,48E-08 |
| SQP [Pt] | 4,60E+01 | 5,45E-01 | 3,72E-02 | 2,50E+01 | N/A | 3,33E-04 | 5,32E-01 | N/A | 8,84E-03 | 4,44E-02 | -1,12E+00 | 3,59E+00 |

Table 28: Additional indicators* ABQM 4.0 DN 25 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-------------------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PM [Disease incidences] | 3,57E-07 | 1,60E-09 | 5,45E-10 | 6,92E-08 | N/A | 1,05E-10 | 4,80E-09 | N/A | 3,22E-10 | 2,44E-09 | -1,09E-07 | 5,87E-08 |
| IRP [kBq U235 eq.] | 7,24E-01 | 5,18E-04 | 4,74E-05 | 1,86E+00 | N/A | 2,84E-05 | 3,48E-03 | N/A | 2,51E-04 | 5,62E-04 | -2,82E-03 | 1,33E-02 |
| ETPfw [CTUe] | 5,68E+01 | 1,30E+00 | 1,78E-01 | 3,02E+01 | N/A | 1,36E-01 | 1,26E+00 | N/A | 3,19E-02 | 4,60E+00 | -1,36E+01 | 5,27E+00 |
| HTPc [CTUh] | 1,70E-07 | 2,69E-11 | 2,84E-12 | 8,69E-10 | N/A | 2,53E-12 | 2,64E-11 | N/A | 2,52E-12 | 3,00E-11 | -6,26E-09 | 3,13E-10 |
| HTPnc [CTUh] | 1,50E-07 | 1,50E-09 | 1,18E-10 | 3,18E-08 | N/A | 1,09E-10 | 1,59E-09 | N/A | 1,70E-10 | 3,05E-09 | -2,70E-08 | 3,57E-08 |
| SQP [Pt] | 5,83E+01 | 7,79E-01 | 4,99E-02 | 2,50E+01 | N/A | 4,79E-04 | 7,62E-01 | N/A | 9,04E-03 | 6,34E-02 | -1,90E+00 | 5,11E+00 |

Table 29: Additional indicators* ABQM 4.0 DN 32 & AME 110

| | A1-A3 | A4 | A5 | B6 | C1 | C2 | C3.1 Recycling | C3.2 Landfill | C4.1 Recycling | C4.2 Landfill | D.1 Recycling | D.2 Landfill |
|-------------------------|----------|----------|----------|----------|-----|----------|-------------------|------------------|-------------------|------------------|------------------|-----------------|
| PM [Disease incidences] | 4,23E-07 | 2,09E-09 | 6,70E-10 | 6,92E-08 | N/A | 1,38E-10 | 6,36E-09 | N/A | 3,21E-10 | 3,20E-09 | -1,39E-07 | 7,88E-08 |
| IRP [kBq U235 eq.] | 8,05E-01 | 6,76E-04 | 5,83E-05 | 1,86E+00 | N/A | 3,74E-05 | 3,63E-03 | N/A | 2,50E-04 | 7,16E-04 | -2,86E-03 | 1,76E-02 |
| ETPfw [CTUe] | 6,54E+01 | 1,70E+00 | 2,19E-01 | 3,02E+01 | N/A | 1,79E-01 | 1,66E+00 | N/A | 3,19E-02 | 6,11E+00 | -1,67E+01 | 7,19E+00 |
| HTPc [CTUh] | 2,59E-07 | 3,51E-11 | 3,50E-12 | 8,69E-10 | N/A | 3,33E-12 | 3,46E-11 | N/A | 2,51E-12 | 3,92E-11 | -9,42E-09 | 4,35E-10 |
| HTPnc [CTUh] | 1,77E-07 | 1,96E-09 | 1,45E-10 | 3,18E-08 | N/A | 1,44E-10 | 2,09E-09 | N/A | 1,70E-10 | 3,99E-09 | -3,12E-08 | 4,80E-08 |
| SQP [Pt] | 6,76E+01 | 1,02E+00 | 6,14E-02 | 2,50E+01 | N/A | 6,31E-04 | 1,00E+00 | N/A | 9,02E-03 | 8,31E-02 | -2,48E+00 | 6,83E+00 |

Table 30: Optional indicator descriptions

| Acronym | Unit | Indicator |
|---------|-------------------|--|
| PM | Disease incidence | Potential incidence of disease due to particulate matter emissions |
| IRP** | kBq U235 eq. | Potential human exposure efficiency relative to U235 |
| ETPfw* | CTUe | Potential Comparative Toxic Unit for ecosystems (fresh water) |
| HTPc* | CTUh | Potential Comparative Toxic Unit for humans (cancer) |
| HTPnc* | CTUh | Potential Comparative Toxic Unit for humans (non-cancer) |
| SQP* | Dimensionless | Potential soil quality index |

*Disclaimer for ADPE, ADPF, WDP, ETPfw, HTPc, HTPnc, SQP: The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

**Disclaimer for ionizing radiation: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

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