Sustainability at BASF Forward AM

Commitment to UN Sustainable Development Goals

As a global leader in advanced materials and 3D printing solutions, we recognize the importance of working towards a sustainable future for all. Forward AM is dedicated to reducing waste throughout our supply chain, minimizing our carbon footprint as well as to continue promoting social responsibility by ensuring fair labor practices and supporting local communities. Our innovative work and collaboration with other like-minded organizations will lead to meaningful progress towards these shared goals.

The only sustainable way forward is together

"Thinking 'sustainability first' while meeting our commitment to drive the industrialization of Additive Manufacturing, we are hyper-aware that we need to reduce our impact on the planet by developing sustainable products, solutions and production methods. We also need to grow our understanding of the overall impact of the 3D printing industry so that we can act and react fast."

Martin Back
CEO and Managing Director

ISO 14001

Nicolas Mathian
Head of Sustainability

“The purpose of ISO 14001 is that it must drive companies to consistently maintain high environmental performance standards by reducing waste, energy usage, and greenhouse gas emissions. This certification creates a solid framework to guide BASF Forward AM through our multiple sustainability initiatives.”

TÜVRheinland®
ZERTIFIZIERT
Management System
ISO 9001:2015
ISO 14001:2015
www.tuv.com
ID 9000003927

ISO 14001 is the International Standard for Environmental Management Systems (EMS) and was designed by the International Organization for Standardization (ISO) to help businesses and other organizations to reduce their environmental impact.

BASF Forward AM is currently ISO 14001 certified at our corporate headquarters in Heidelberg, Germany with a current focus to certify our Emmen location in the Netherlands planned to follow in 2024.

Thinking ‘sustainability first'

We commit to reducing our impact on the planet by developing sustainable products, solutions, and production methods and studying the impact of the 3D Printing industry.

#ProjectZero

Reduce

Lead

Empower

Reduce

“We develop products, solutions, and production methods that enable the future of sustainable manufacturing.”

Developing materials with sustainability in mind

Recycled

Made from post-consumer or post-industrial plastic waste

Ultrafuse® rPET (recycled PET)
Ultrasint® PA11 rCF

Bio-based

Derived from renewable resources such as plants, crops, or algae

Ultrafuse® PLA
Ultrafuse® PLA Tough
Ultrasint® PA11
Ultrasint® PA11 Black
Ultrasint® PA11 CF
Ultrasint® PA11 ESD

Recyclable

Can be collected and processed to create new products after their initial use.

Ultrasint® AP26
Ultrasint® PA11
Ultrasint® PA11 Black
Ultrasint® PA11 CF
Ultrasint® PA11 ESD
Ultrasint® PP 1400 Black
Ultrasint® TPU01
Ultrasint® TPU88A
Ultrasint® TPU88A Black
HP 3D HR PP

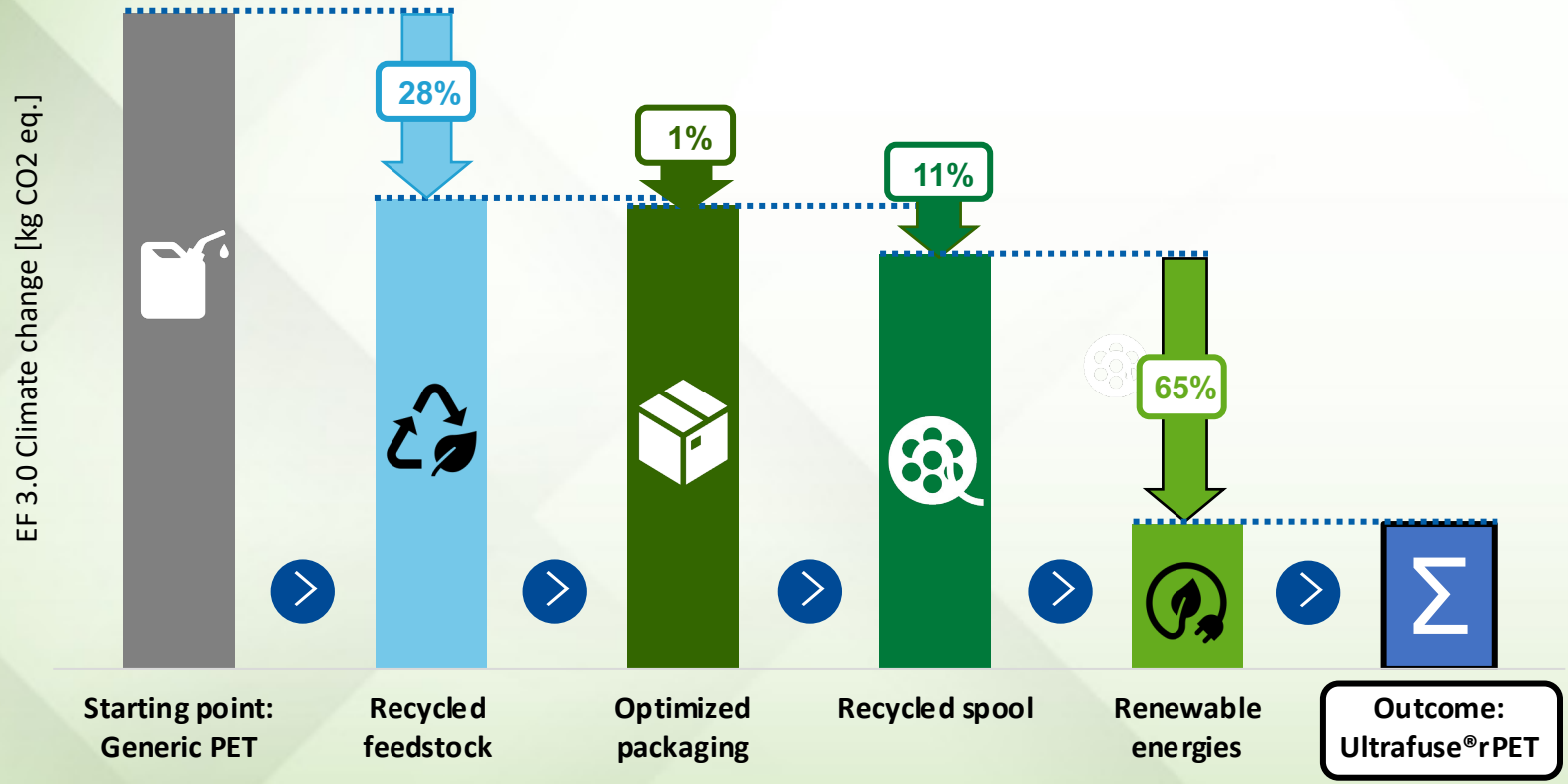
Ultrafuse® TPS 90A
Ultrafuse® TPU 64D
Ultrafuse® TPU 85A
Ultrafuse® TPU 95A
Ultrafuse® ABS
Ultrafuse® ABS Fusion+
Ultrafuse® ASA
Ultrafuse® BVOH
Ultrafuse® HiPS
Ultrafuse® PA
Ultrafuse® PA6 GF30

Ultrafuse® PAHT CF15
Ultrafuse® PC GF30
Ultrafuse® PC/ABS FR
Ultrafuse® PET
Ultrafuse® PET CF15
Ultrafuse® PLA
Ultrafuse® PLA PRO1
Ultrafuse® PP
Ultrafuse® PP GF30
Ultrafuse® PPSU
Ultrafuse® rPET

30+ recycleable materials

Measuring the impact helps to make our materials more sustainable

CO_2 footprint [kg CO_2 eq.]:



BASF Sustainability measures

- Recycled feedstock
- Optimized packaging
- Recycled spool
- Renewable energies

*LCIA methodology:
- EF3.0 Climate change for Product Carbon Footprint

**Analysis scope and functional unit:
- Cradle to gate on 1kg of filament

Ultrafuse® rPET has a **78%** lower CO2 footprint compared to generic PETs.

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Renewable Energy at our production sites

As we work toward implementing more sustainable practices throughout our organization, we have moved from fossil-based energy to Dutch wind and solar energy at our production site in Emmen.

Sculpteo in Paris, France also switched to a provider of renewable energy.

This change in how we work led to a reduction in our carbon footprint and the product's footprint over the past year.

Reducing the impact of our Packaging

All our Ultrafuse® spools are based on 90 – 100% recycled raw material. The material is based on either one or both, postconsumer and post-production resources. This statement is in reference to the NEN-EN-ISO 14021.

The Ultrafuse® cardboard retail box which protect our product is credible forest certified.

The Forest Stewardship Council® (FSC®) helps take care of forests and the people and wildlife who call them home. What does the label mean? Simply put, by choosing products with FSC labels, you are contributing to the protection of forests worldwide.

Lead

“We study the impact of 3D printing to enrich the discourse of sustainability across the industry.”

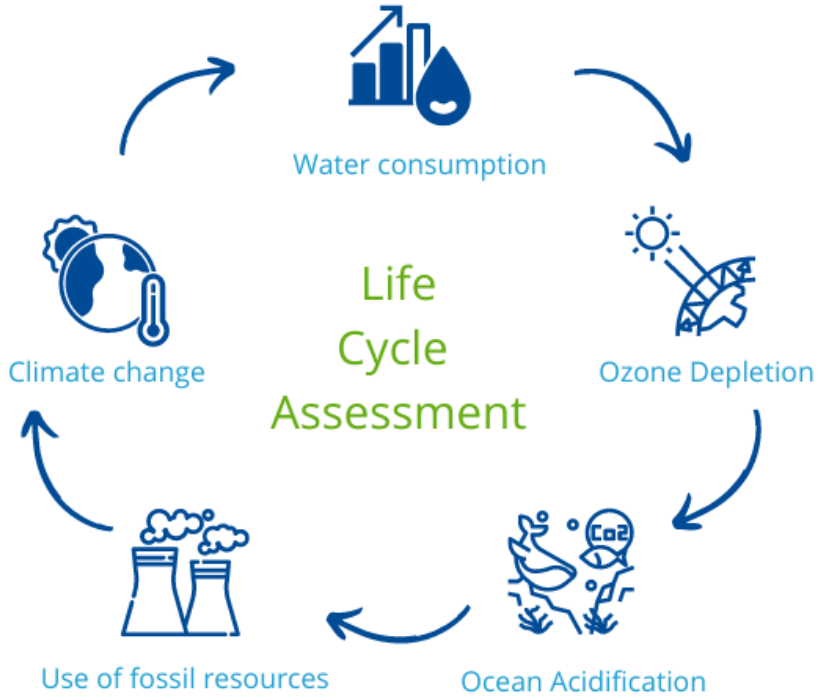
Measuring the impact of our materials

Life Cycle Assessment:

a study that calculates the environmental impacts that are associated with every step of the production of a product.

BASF Forward AM currently offers LCAs for

- HP 3D High Reusability PP
- Ultrasint® PA11, PA11 Black
- Ultrasint® TPU01, TPU 88A
- Ultrasint® PP 1400 Black
- Ultrafuse® PLA
- Ultrafuse® ABS
- Ultrafuse® rPET, PET

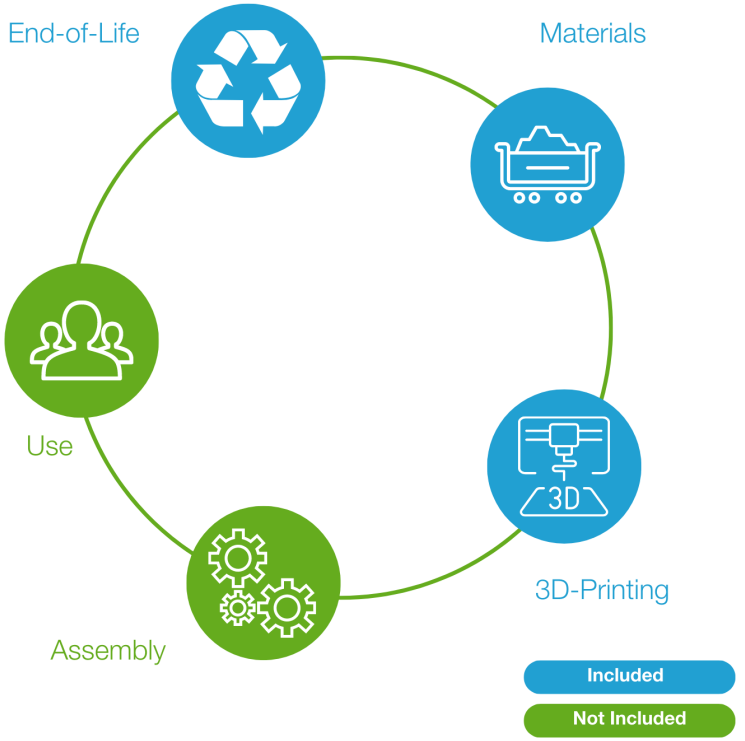


All LCAs follow the PEF methodology EF 3.0 in line with the ISO Standard 14040 : 2006 and ISO 14044 : 2006 methodology.

CO2 Calculation as a Service: Ultrasim® 3D Sustainability Analysis

We are working on creating Life Cycle Assessments (LCA) for our products and help our customers understand the environmental footprint for a 3D printed part with this new service offering.

Learn More



Ultrasim® 3D Sustainability Analysis (LCA) - BETA

		STARTER Material LCA	PREMIUM Part LCA Service (CO2)	ENTERPRISE Become a Partner
What you get	LCA material report	✓	✓	✓
	CO2 footprint report of 3D printed part		✓	✓
	Add your printer			✓
	Integrate LCA data to your software			✓
3D printing materials	Ultrasint® Powder	• Ultrasint® TPU 01 and 88A • Ultrasint® PP 1400 • Ultrasint® PA11 and PA11 Black	• Ultrasint® TPU 01 • Ultrasint® TPU 88A (coming soon) • Ultrasint® PP 1400 (coming soon) • Ultrasint® PA11 and PA11 Black (coming soon)	BASF Forward AM Materials
	Ultrafuse® Filaments	• Ultrafuse® PLA • Ultrafuse® ABS • Ultrafuse® PET • Ultrafuse® rPET	• Ultrafuse® PLA • Ultrafuse® ABS • Ultrafuse® PET • Ultrafuse® rPET	
3D printing machines	Ultrasint® Powder		• HP JF 52XX • SLS printers (coming soon)	Your printer
	Ultrafuse® Filaments		• Ultimaker S5 • FFF printers (extension possible)	
	Get your Add-on:		• Extended LCA with all 16 impact categories • Ultrasim® 3D Cost Analysis (TCO) • Comparison to conventional manufacturing • Carbon Footprint compensation	
	What we need from you:		• STL-file of your part • Input report (production setup)	• 1 hour of your time to understand your problem and derive a solution concept
	Price:	**Free of Charge**	**Starting at 3.500 €**	**On request**
	Lead time:	**14 days**	**On request**	**On request**

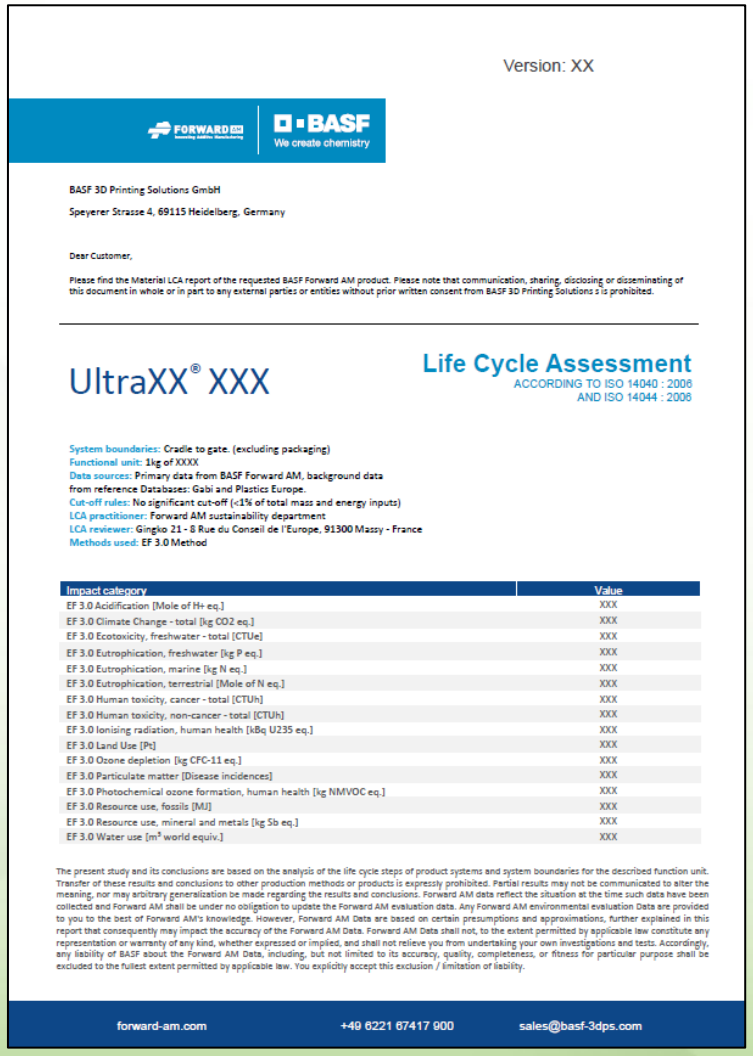
Ultrasim® 3D Sustainability Analysis (LCA) - BETA

Starter: Material LCA

S P E

Material

Assessment conditions



Version: XX

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BASF 3D Printing Solutions GmbH

Speyerer Strasse 4, 69115 Heidelberg, Germany

Dear Customer,

Please find the Material LCA report of the requested BASF Forward AM product. Please note that communication, sharing, disclosing or disseminating of this document in whole or in part to any external parties or entities without prior written consent from BASF 3D Printing Solutions is prohibited.

UltraXX® XXX

Life Cycle Assessment
ACCORDING TO ISO 14040 : 2006
AND ISO 14044 : 2006

System boundaries: Cradle to gate. (excluding packaging)
Functional unit: 1kg of XXXX
Data sources: Primary data from BASF Forward AM, background data from reference Databases: Gabi and Plastics Europe.
Cut-off rules: No significant cut-off (<1% of total mass and energy inputs)
LCA practitioner: Forward AM sustainability department
LCA reviewer: Gingko 21 - 8 Rue du Conseil de l'Europe, 91300 Massy - France
Methods used: EF 3.0 Method

Impact category	Value
EF 3.0 Acidification [Mole of H+ eq.]	XXX
EF 3.0 Climate Change - total [kg CO2 eq.]	XXX
EF 3.0 Ecotoxicity, freshwater - total [CTUe]	XXX
EF 3.0 Eutrophication, freshwater [kg P eq.]	XXX
EF 3.0 Eutrophication, marine [kg N eq.]	XXX
EF 3.0 Eutrophication, terrestrial [Mole of N eq.]	XXX
EF 3.0 Human toxicity, cancer - total [CTUh]	XXX
EF 3.0 Human toxicity, non-cancer - total [CTUh]	XXX
EF 3.0 Ionising radiation, human health [kBq U235 eq.]	XXX
EF 3.0 Land Use [Pt]	XXX
EF 3.0 Ozone depletion [kg CFC-11 eq.]	XXX
EF 3.0 Particulate matter [Disease incidences]	XXX
EF 3.0 Photochemical ozone formation, human health [kg NMVOC eq.]	XXX
EF 3.0 Resource use, fossils [MJ]	XXX
EF 3.0 Resource use, mineral and metals [kg Sb eq.]	XXX
EF 3.0 Water use [m³ world equiv.]	XXX

The present study and its conclusions are based on the analysis of the life cycle steps of product systems and system boundaries for the described function unit. Transfer of these results and conclusions to other production methods or products is expressly prohibited. Partial results may not be communicated to alter the meaning, nor may arbitrary generalization be made regarding the results and conclusions. Forward AM data reflect the situation at the time such data have been collected and Forward AM shall be under no obligation to update the Forward AM evaluation data. Any Forward AM environmental evaluation Data are provided to you to the best of Forward AM's knowledge. However, Forward AM Data are based on certain presumptions and approximations, further explained in this report that consequently may impact the accuracy of the Forward AM Data. Forward AM Data shall not, to the extent permitted by applicable law constitute any representation or warranty of any kind, whether expressed or implied, and shall not relieve you from undertaking your own investigations and tests. Accordingly, any liability of BASF about the Forward AM Data, including, but not limited to its accuracy, quality, completeness, or fitness for particular purpose shall be excluded to the fullest extent permitted by applicable law. You explicitly accept this exclusion / limitation of liability.

forward-am.com +49 6221 67417 900 sales@basf-3dps.com

Environmental data in 16 impact categories [according to EF 3.0]

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Ultrasim® 3D Sustainability Analysis (LCA) - BETA

Premium: Example LCA

S P E

Life Cycle Assessment conditions

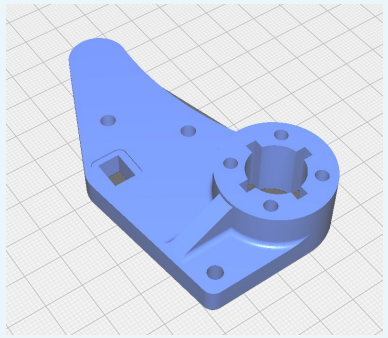
Functional unit :
We assume the functional unit to be **one complete build job** of this **BASF mount** printed on a **HP MJF 52XX** 3D printer. Every part printed with acceptable quality is the desired outcome.

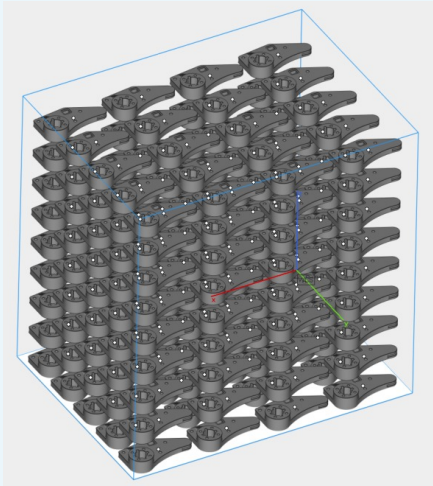
Goal of the study :
Measuring the impact **of part fabrication in MJF** specifically on the **HP MJF 52XX** using a **Ultrasint powders** including all impact categories

Scope of the study :
Cradle to Gate

Methodology used:
EF 3.0

Cutoff criteria:
95% of all impacts





Production setup:

- Machine : HP MJF 52XX
- Total parts per build job: 180 parts
- Finish : Raw (Sandbasted part)
- Location: Europe
- Energy Mix

Assumptions:

- Study not critically reviewed [But materials currently in progress]
- Part packaging and transport of printed part neglected
- Assembly, use phase and end of life treatment of printed part neglected
- Production in Europe Electricity grid mix for Europe used
- Part scrap rates and build scene not validated in production environment

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Ultrasim® 3D Sustainability Analysis (LCA) - BETA

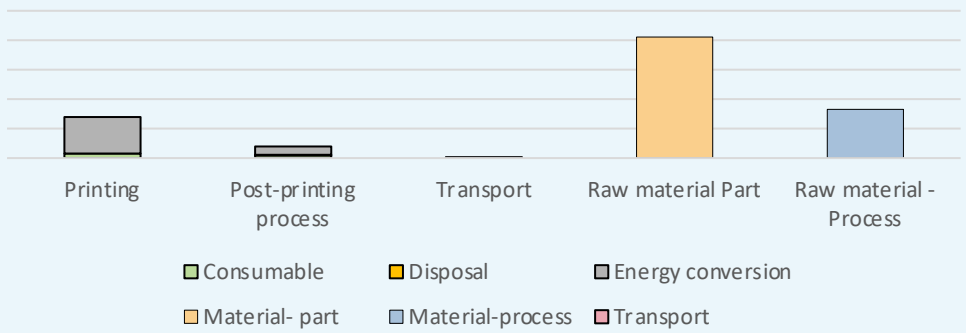
Premium: CO2 Footprint Report of 3D Printed Part

S P E

Part carbon footprint

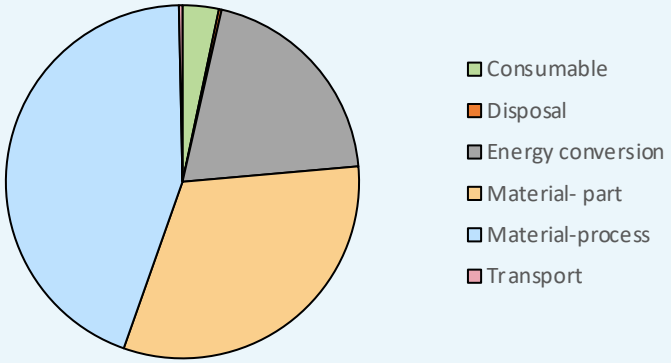
XXX
kg CO2 Eq

Process hotspots:

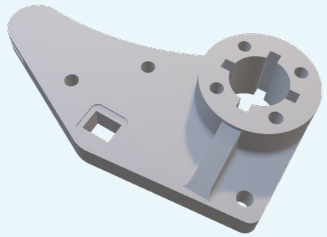


Scope of analysis:

Hotspots in absolute quantities:



Future optimization potiential:



- Optimization scenario 1
- Optimization scenario 2
- …..

Climate change:

XX %
of overall environmental impact of the part

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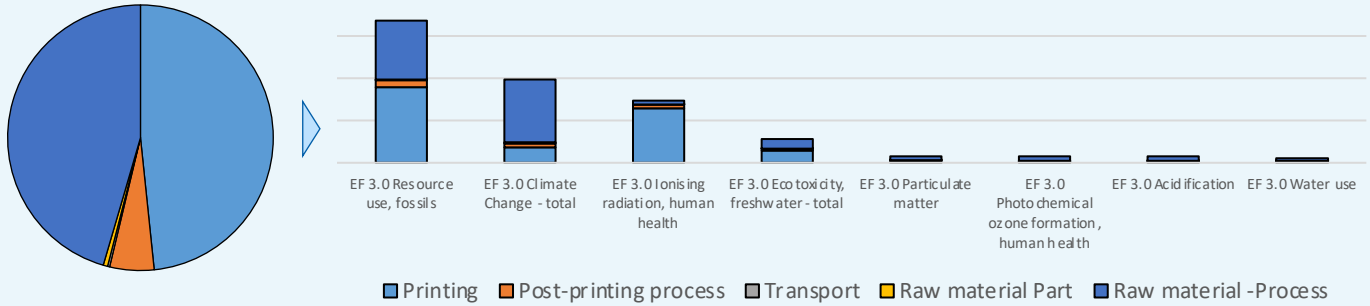
Ultrasim® 3D Sustainability Analysis (LCA) - BETA

Premium: Environmental Report Footprint Report of 3D Printed Part

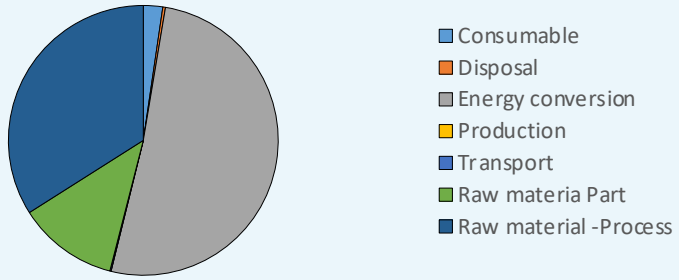
S P E

Normalised and weighed results

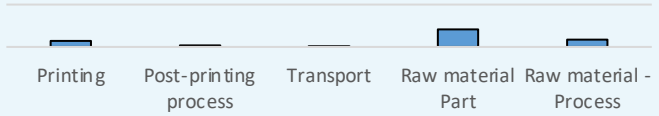
Process split: Normalised and weighed results



Quantity based split: normalised and weighed results

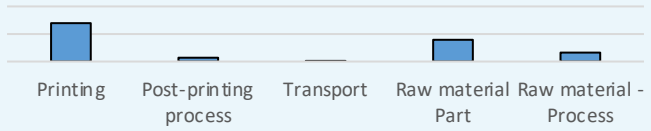


Climate change [CO2 eq]



XX kg CO2eq

Resource use – fossils [MJ]



XX MJ

Takeaways

- Highest contributing impact categories
- Quantity based hotspots
- Process hotspots

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Ultrasim® 3D Sustainability Analysis (LCA) - BETA

Premium: Example Applications

S P E

Helmet:

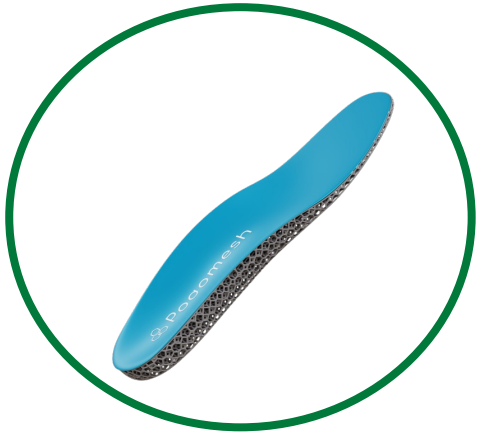
5.08 kg CO2 eq

- **Technology**: HP MJF
- **Material:** Ultrasint® TPU01
- **LCIA methodology:** EF 3.0 Climate change
- **Scope:** Cradle to gate (raw material extraction to printed part production)
- **Printing location for LCA:** France

Saddle:

2.62 kg CO2 eq

- **Technology:** HP MJF
- **Material:** Ultrasint® TPU01
- **LCIA methodology:** EF 3.0 Climate change
- **Scope:** Cradle to gate (raw material extraction to printed part production)
- **Printing location for LCA:** France



Insole:

1.84 kg CO2 eq

- **Technology**: HP MJF
- **Material:** Ultrasint® TPU01
- **LCIA methodology**: EF 3.0 Climate change
- **Scope:** Cradle to gate (raw material extraction to printed part production)
- **Printing location for LCA:** France

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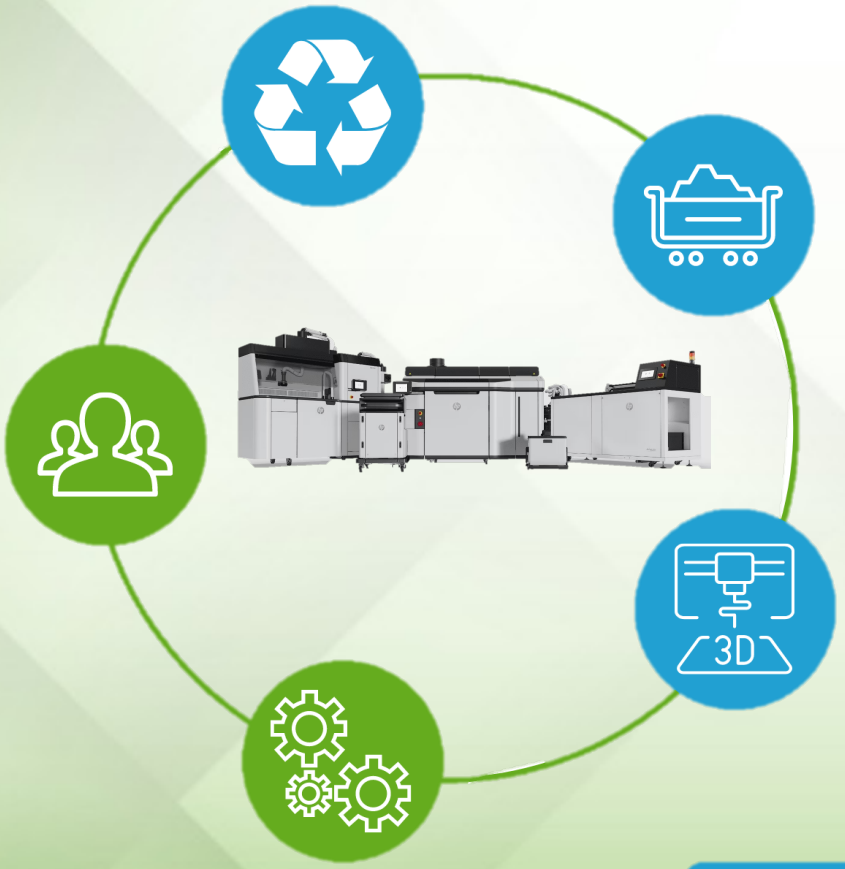
Ultrasim® 3D Sustainability Analysis (LCA) - BETA

Enterprise: Become a Partner

S P E

1 Offer customized LCAs with your printer:



Included

Not Included

2 Integrate LCA data to your software/database

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Empower

“We create positive change at the grass-roots, knowing that every contribution adds up to make a meaningful difference.”

Offsetting the impact:
Carbon Compensation

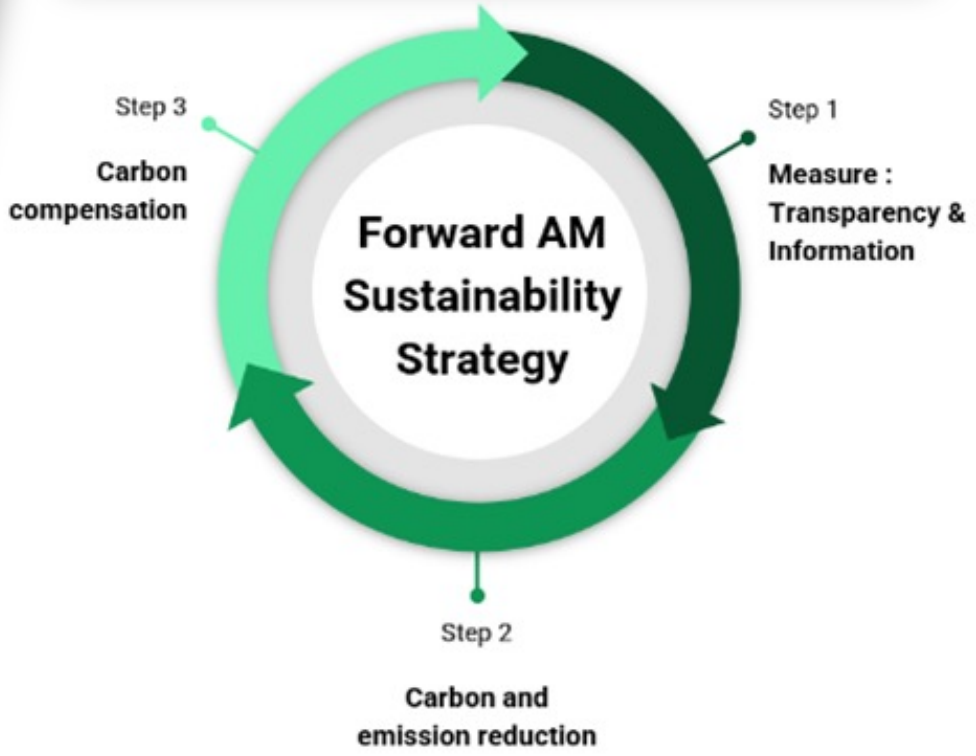
BASF Forward AM launched the Carbon Compensation (CC) program to counterbalance what we cannot reduce to go full circle as responsible environmental stewards.

With our LCA studies we calculate the carbon emission of our materials and offer carbon credits. We work with accredited organizations to finance projects that result in long-term carbon capture, which offset the unavoidable emissions that are created during the manufacturing process.

More information

BASF Forward AM currently offers Carbon Compensation for

PP Powders TPU Powders



Recycling materials and obsolete parts
Arkema Virtucycle® Program

Virtucycle® ARKEMA

BASF Forward AM has partnered with Arkema to offer a new take back program to recycle 3D printed PBF (powder bed fusion) parts and materials.

Learn More

Offered by Forward AM to provide eco-design expertise, recyclability and recycling guarantees as well as recycled high-performance polymers

Recycle used polyamide 11 powders and printed parts through reengineering and re-compounding

Ultrasint® TPU recycling Program

BASF Forward AM recycles TPU by-products and waste, converting them back into usable pellets. This sustainable approach ensures the efficient reuse of materials.

RECYCLABLE

- ✓ TPU powder (including cake powder and agglomerates)
- ✓ TPU printed parts

NOT RECYCLABLE

- x Dyed, coated, or vapor smoothed parts
- x Assembled or glued parts

Join us

Project Zero is a call to work together across the industry and with our customers.

Let’s join forces to reduce our impact

Nicolas Mathian
Head of Sustainability

Marius Haefele
Product Manager Services

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Head of Service and Solutions

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