

Environmental Sustainability and Economic Assessment of Additive Manufacturing: The Influence of Polymer Type and Layer Definition

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SUPPLEMENTARY FILES

FIGURES

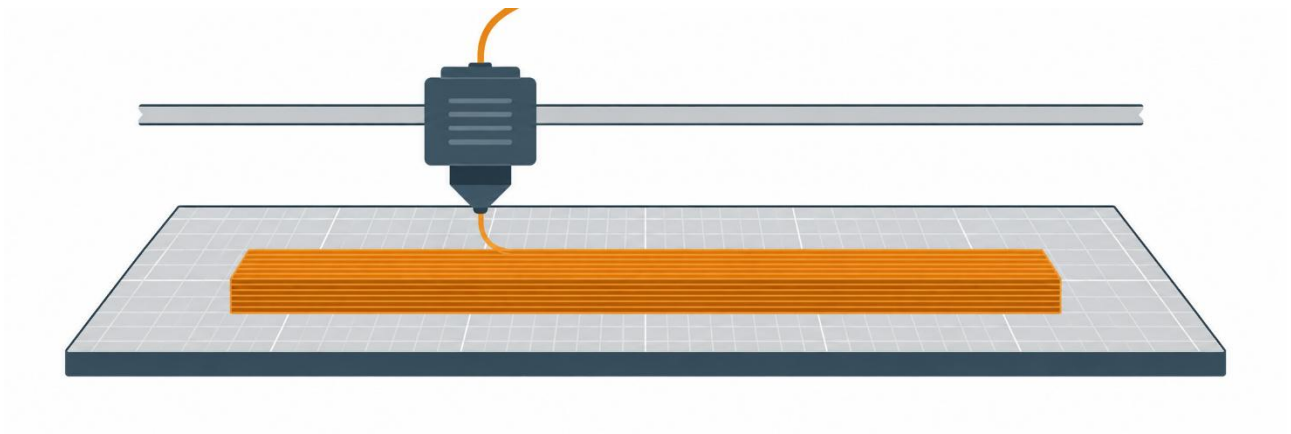


Figure S1. 3D printing item considered in the analysis.

TABLES

Table S1: Printer power and time for the materials and settings. DM: draft mode, QM: quality mode,
UM: ultradetail mode.

Material	Power (W)	Time DM (hours)	Time QM (hours)	Time UM (hours)
ABS	120	0.57	1.05	4.12
FLEX	100	2.30	2.25	4.17
HIPS	100	0.57	1.05	4.12
PETG	100	0.60	1.05	4.12
PLA	80	0.57	1.05	4.12

Table S2: Inventory of economic analysis (EA).

Material or process	Acronyms	Amount	Unit
<i>Materials</i>			
ABS filament	-	25.00	EUR/kg
FLEX filament	-	45.00	EUR/kg
HIPS filament	-	35.00	EUR/kg
PETG filament	-	25.00	EUR/kg
PLA filament	-	21.00	EUR/kg
<i>Energy</i>			
Electricity tariff	ET	0.10	EUR/kWh
<i>Printer depreciation</i>			
Printer purchase	PP	1576.00	EUR
Printer lifetime	PL	1825	Days
Daily usage	DU	2	Hours
Hours in life	-	3650	Hours
Depreciation per hour	-	0.43	EUR/hours
<i>Printer repairs</i>			
Repair cost	RCS	10	%
Repairs per hours	-	0.04	EUR/hours
<i>Failures</i>			
Failures rate	FR	10	%
<i>Other</i>			
Other costs	OC	0.10	EUR

Table S3: Environmental impact categories for one 3D printed item.

<i>Draft mode</i>						
<i>Impact category</i>	<i>Unit</i>	<i>ABS</i>	<i>FLEX</i>	<i>HIPS</i>	<i>PETG</i>	<i>PLA</i>
GW	kg CO ₂ eq	6.40E-02	8.53E-02	5.20E-02	5.03E-02	4.80E-02
SOD	kg CFC11 eq	1.00E-08	6.33E-08	7.42E-09	2.25E-07	1.35E-07
IR	kBq Co-60 eq	1.35E-02	4.75E-02	1.12E-02	1.44E-02	1.11E-02
OFh	kg NO _x eq	1.11E-04	1.95E-04	9.89E-05	1.04E-04	1.19E-04
PM	kg PM2.5 eq	5.68E-05	1.07E-04	4.93E-05	5.84E-05	7.58E-05
OFe	kg NO _x eq	1.19E-04	2.09E-04	1.05E-04	1.15E-04	1.28E-04
TA	kg SO ₂ eq	1.62E-04	2.64E-04	1.47E-04	1.48E-04	1.93E-04
FE	kg P eq	8.08E-06	2.82E-05	4.66E-06	1.48E-05	2.28E-05
ME	kg N eq	1.62E-06	2.77E-06	6.32E-07	1.49E-06	1.82E-05
TE	kg 1,4-DCB	8.55E-02	3.02E-01	7.47E-02	1.62E-01	1.14E-01
FEC	kg 1,4-DCB	3.27E-03	1.16E-02	2.64E-03	4.43E-03	3.97E-03
MEC	kg 1,4-DCB	4.10E-03	1.46E-02	3.31E-03	5.63E-03	4.93E-03
HCT	kg 1,4-DCB	5.11E-03	1.68E-02	3.23E-03	9.57E-03	7.34E-03
HCnT	kg 1,4-DCB	3.99E-02	1.52E-01	3.12E-02	7.03E-02	6.31E-02
LU	m ² a crop eq	8.16E-04	3.33E-03	6.57E-04	1.49E-03	2.55E-02
MSS	kg Cu eq	1.25E-04	5.00E-04	9.63E-05	2.64E-04	1.91E-04
FRS	kg oil eq	2.63E-02	3.09E-02	2.32E-02	2.20E-02	1.29E-02
WC	m ³	8.05E-04	1.37E-03	7.13E-04	4.12E-04	1.69E-03
<i>Quality mode</i>						
<i>Impact category</i>	<i>Unit</i>	<i>ABS</i>	<i>FLEX</i>	<i>HIPS</i>	<i>PETG</i>	<i>PLA</i>
GW	kg CO ₂ eq	7.47E-02	8.33E-02	6.10E-02	6.44E-02	5.53E-02
SOD	kg CFC11 eq	1.70E-08	6.17E-08	1.33E-08	2.58E-07	1.37E-07
IR	kBq Co-60 eq	2.49E-02	4.64E-02	2.06E-02	2.35E-02	1.86E-02
OFh	kg NO _x eq	1.38E-04	1.91E-04	1.21E-04	1.36E-04	1.36E-04
PM	kg PM2.5 eq	7.12E-05	1.04E-04	6.13E-05	7.57E-05	8.49E-05

OFe	kg NO _x eq	1.47E-04	2.04E-04	1.28E-04	1.49E-04	1.46E-04
TA	kg SO ₂ eq	2.02E-04	2.58E-04	1.80E-04	1.94E-04	2.18E-04
FE	kg P eq	1.16E-05	2.75E-05	7.64E-06	1.90E-05	2.48E-05
ME	kg N eq	1.97E-06	2.70E-06	9.46E-07	1.93E-06	1.81E-05
TE	kg 1,4-DCB	1.37E-01	2.95E-01	1.17E-01	2.16E-01	1.47E-01
FEC	kg 1,4-DCB	5.63E-03	1.13E-02	4.61E-03	6.53E-03	5.51E-03
MEC	kg 1,4-DCB	7.04E-03	1.42E-02	5.76E-03	8.26E-03	6.84E-03
HCT	kg 1,4-DCB	7.40E-03	1.64E-02	5.16E-03	1.23E-02	8.80E-03
HChT	kg 1,4-DCB	6.56E-02	1.49E-01	5.26E-02	9.60E-02	7.96E-02
LU	m ² a crop eq	1.42E-03	3.25E-03	1.16E-03	2.07E-03	2.54E-02
MSS	kg Cu eq	2.13E-04	4.89E-04	1.70E-04	3.55E-04	2.47E-04
FRS	kg oil eq	2.93E-02	3.01E-02	2.56E-02	2.71E-02	1.51E-02
WC	m ³	9.70E-04	1.34E-03	8.50E-04	5.82E-04	1.78E-03

Ultradetail mode

Impact category	Unit	ABS	FLEX	HIPS	PETG	PLA
GW	kg CO ₂ eq	1.51E-01	1.23E-01	1.24E-01	1.28E-01	1.06E-01
SOD	kg CFC11 eq	6.18E-08	8.48E-08	5.07E-08	2.93E-07	1.66E-07
IR	kBq Co-60 eq	9.72E-02	8.41E-02	8.10E-02	8.38E-02	6.69E-02
OFh	kg NO _x eq	3.19E-04	2.85E-04	2.72E-04	2.87E-04	2.57E-04
PM	kg PM2.5 eq	1.69E-04	1.55E-04	1.43E-04	1.57E-04	1.50E-04
OFe	kg NO _x eq	3.38E-04	3.03E-04	2.87E-04	3.08E-04	2.73E-04
TA	kg SO ₂ eq	4.73E-04	3.99E-04	4.06E-04	4.20E-04	3.98E-04
FE	kg P eq	3.46E-05	3.94E-05	2.69E-05	3.81E-05	4.00E-05
ME	kg N eq	4.42E-06	3.97E-06	3.00E-06	3.97E-06	1.96E-05
TE	kg 1,4-DCB	4.68E-01	4.67E-01	3.93E-01	4.92E-01	3.68E-01
FEC	kg 1,4-DCB	2.08E-02	1.92E-02	1.73E-02	1.92E-02	1.56E-02
MEC	kg 1,4-DCB	2.59E-02	2.40E-02	2.15E-02	2.39E-02	1.94E-02
HCT	kg 1,4-DCB	2.24E-02	2.42E-02	1.77E-02	2.47E-02	1.88E-02

HCnT	kg 1,4-DCB	2.31E-01	2.35E-01	1.91E-01	2.34E-01	1.90E-01
LU	m ² a crop eq	5.29E-03	5.26E-03	4.39E-03	5.29E-03	2.77E-02
MSS	kg Cu eq	7.77E-04	7.82E-04	6.41E-04	8.24E-04	6.24E-04
FRS	kg oil eq	5.18E-02	4.19E-02	4.44E-02	4.59E-02	3.02E-02
WC	m ³	2.12E-03	1.94E-03	1.81E-03	1.54E-03	2.54E-03

Impact categories acronyms - GW: Global warming; SOD: Stratospheric ozone depletion; IR: Ionizing radiation; OFh: Ozone formation, human health; PM: Fine particulate matter formation; OFe: Ozone formation, terrestrial ecosystems; TA: Terrestrial acidification; FE: Freshwater eutrophication; ME: Marine eutrophication; TE: Terrestrial ecotoxicity; FEC: Freshwater ecotoxicity; MEC: Marine ecotoxicity; HCT: Human carcinogenic toxicity; HCnT: Human non-carcinogenic toxicity; LU: Land use; MSS: Mineral resource scarcity; FRS: Fossil resource scarcity; WC: Water consumption.