Environmental Product Declaration

In accordance with ISO 14025 for:

[*Pomini Digital Texturing™ (PDT™) Machine*]

from

[*Tenova-Pomini*]

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-03100
Publication date:	2021-09-10
Valid until:	2022-07-22

Programme information

Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com

Product category rules (PCR): *MACHINE-TOOLS FOR WORKING MATERIALS BY REMOVAL OF MATERIAL, BY LASER OR SIMILAR PROCESSES, registration number (not yet available), draft version 1.0, UN CPC code: 44211*
PCR review was conducted by: *Not yet available*
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: Vito D'Incognito, *Independent approved verifier* *In case of accredited certification bodies:* Accredited by: <*name of the accreditation body and accreditation number, where applicable*>. *In case of recognised individual verifiers:* Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable.
The present document is intended to be a pre-certification EPD. As soon as the PCR named *MACHINE-TOOLS FOR WORKING MATERIALS BY REMOVAL OF MATERIAL, BY LASER OR SIMILAR PROCESSES* will be published, the EPD will be certified.

Company information

Owner of the EPD: Tenova S.p.A, Via Gerenzano, 58, 21053 Castellanza (Varese), Italy pomini@tenova.com; +39 0331 444111

Contact person:

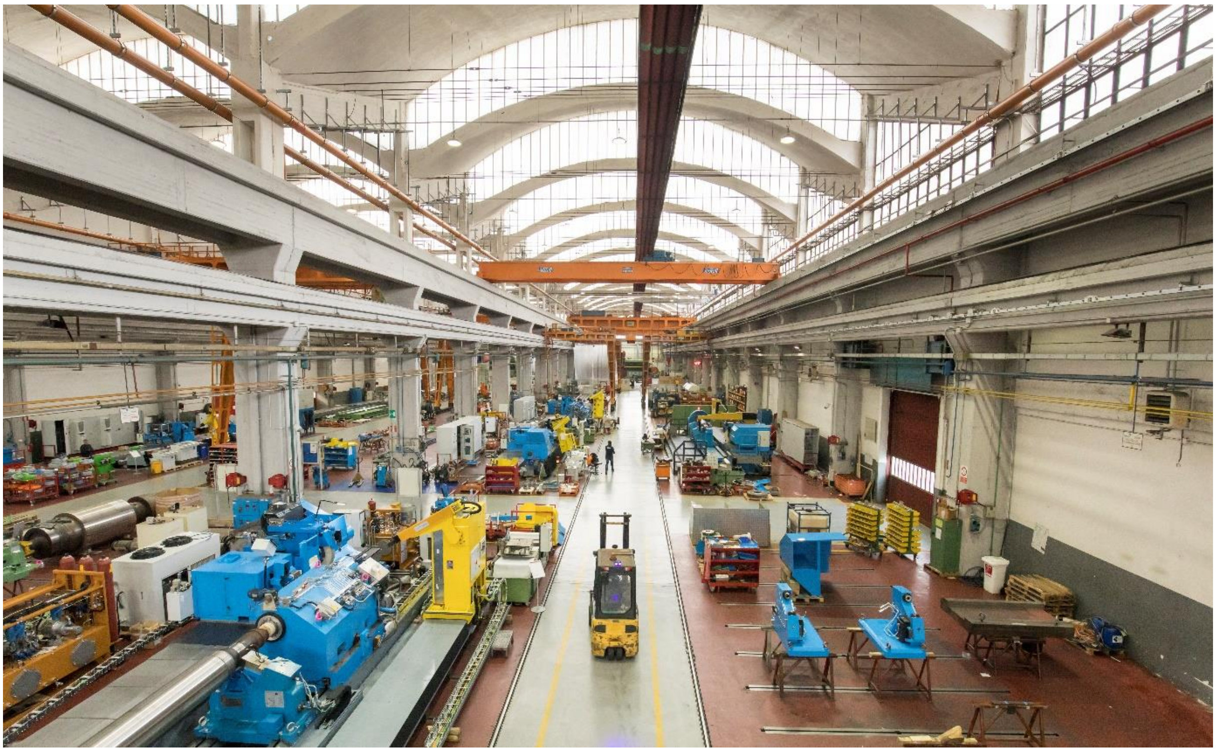
Paolo Gaboardi, +39 0331444356, paolo.gaboardi@tenova.com, Via Gerenzano, 58, 21053 Castellanza (Varese), Italy

Enrico Malfa, +39 0331 444874 enrico.malfa@tenova.com, Via Gerenzano, 58, 21053 Castellanza (Varese), Italy

Description of the organisation: Pomini is the Tenova brand worldwide leader in the production of roll grinders and other roll shop equipment, as well as in the supply of fully automated Roll Shops. . Tenova, a Techint Group company, is a worldwide partner for sustainable, innovative and reliable solutions in the metals and – through the well-known TAKRAF and DELKOR brands – in the mining industries. Tenova leverages a workforce of over 2,300 forward-thinking professionals located in 19 countries across 5 continents, who design technologies and develop services that help companies reduce costs, save energy, limit environmental impact and improve working conditions. The company's headquarters are located in Castellanza (Italy). This EPD is the result of a Life Cycle Assessment of the PDT™ machine. This study is configured within Tenova's integrated environmental policy.

This sustainability policy aims to obtain the first certified products in the industrial sector of laser texturing machines and to support further eco-design policies for existing and new products, as well as for the Castellanza workshop according to the targets identified by the Environmental Group Policy. Tenova's approach to sustainability can be summed up as "sustenovability, a neologism that embodies the blend between the Tenova brand, its eco-friendly values and its capacity to deliver sustainable solutions." The company cooperates with clients, carefully analysing their industrial processes in order to identify solutions that will reduce energy consumption and environmental impact. In particular, the company focuses on limiting raw material waste and improving facility efficiency. Tenova Pomini's aim is to be the clients' first choice by offering a portfolio of "green tech" solutions that reduce environmental impact while saving energy. The study is focused on the Castellanza Facility that is displaced on area of 96.000 squared meters. The site is located in the Varese province, in northern Italy. The site is the company's headquarters, where more than 400 people work and all the activities of industrial design, technology and development of Tenova-Pomini products are carried out.

Product-related or management system-related certifications: The Castellanza site is part of high tracking and standardization policies whose aim is to guarantee quality both to suppliers and customers. In particular, the Castellanza site certifications are: ISO 9001:2015, ISO 14001:2015, ISO 45001:2018.
Name and location of production site: Production facility in Castellanza - Via Gerenzano, 58, 21053 Castellanza (Varese), Italy



Product information

Product name: Pomini Digital Texturing™ (PDT™) Machine
Product identification: Model: PDT 310-2-2 / Serial: PDT013-16
Product description: Pomini Digital Texturing™ is a technology developed for surface texturing of rolling mill work rolls. A digital process, based on modern fiber laser, allows wider range of textured surfaces in comparison to other existing texturing technologies, both in the steel and aluminium industries. The expected service life time is 30 years. PDT™ offers the possibility to control Wa (waviness, as defined in ISO 4287:1997) of the textured surface, as well as independently controlling Ra (roughness, as defined in BS EN 10049:2005) and Rpc (number of peaks per centimeter, as defined in BS EN 10049:2005). It is a digital machine which can both stochastically and deterministically implement specific surface features, which are first engineered, and then realized on the roll surface. The crater's shape, dimension and distribution can be controlled as well. PDT™ does not need any fire extinguishing system, (which is generally provided by CO2 systems). PDT™ is protected by several patents, and the system can work with different inert gases, such as argon and nitrogen.

An important feature of the processing performed with PDT™ is related to the increase in surface hardness. According to certified studies, the related macro hardness on the reference roll surface varies between 740 and 720 HV. In terms of microscopic features, the micro hardness measurements of specific crater zones show that the PDT™ process produces crystals with hardness (900 HV5) 30% higher than that of the equivalent surface finishing by electrochemical processes (650 HV5). This micro-hardness study can confirm a longer life of the rolls inside the mill stand and the avoidance of surface treating for textured rolls by hexavalent chromium (CR-VI). Even if the PDT™ process does not replace treatment with Cr-VI, it can constitute an effective solution to increase the productivity of each textured roll.

The following table resumes main PDT™ features:

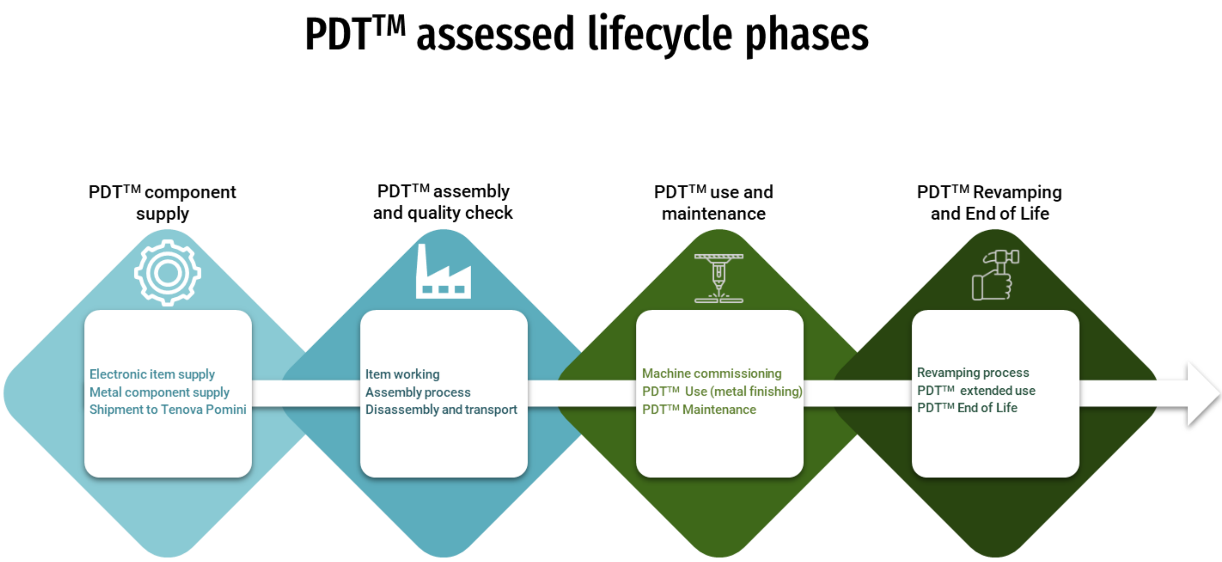
Feature	**Options**	**PDT™**
Processing type for Surface	Stochastic (Random) and Deterministic	Working of stochastic and deterministic surfaces based on digitally designed morphologies.
Other introduced features	introduced Further surface features by processing	Certified microhardness on metal surfaces worked by PDT™ process
Working control	Control of working area at microscopic level	Possibility to control shape dimension and distribution of the single crater
Safety	Specific solution to prevent risks	No need for CO_2 fire extinguishing system on board
Trademark	Patented solution for finishing	PDT™ process is patented
Machine operational flexibility	Changes in machine configuration	Change in configuration with 1 active laser/ 2 active laser heads/ 4 active laser heads
Ancillary gases	Use of supplementary gases for finishing	Inert gas (Nitrogen/Argon)

UN CPC code: 44211

Geographical scope: Europe
Base case - Europe – Sensitivity analysis for other location

LCA information

Declared unit: production of a square meter of laser-textured rolling mill roll, with 2 active lasers and nitrogen as inert gas. The textured rolling mill roll has an average Ra (roughness as defined in BS EN 10049:2005) equal to 1.5 μm and a Rpc (number of peaks per centimeter, as defined in BS EN 10049:2005) equal to 85, measured with a cut-off distance (λc) equal to 2.5 mm; a Rsk parameter (which represents the degree of bias either in the upward or downward direction of an amplitude distribution curve, as defined in ISO 4287:1997) equal to -0.37.
Reference service life: 30 years, operated in Europe, 20 hours/day for 250 days/year.
Time representativeness: the LCA covered 2019 data
Database(s) and LCA software used: Ecoinvent 3.6 cut-off by classification, unit, Software Open LCA 1.10.3
System diagram:



Description of system boundaries: [cradle-to-grave]
Excluded lifecycle stages: [no lifecycle stages were excluded]
More information: https://www.tenova.com/product/processing-pomini-digital-texturing/
Name and contact information of LCA practitioner (Carlo Brondi carlo.brondi@stiima.cnr.it , Davide Rovelli davide.rovelli@stiima.cnr.it , Elisabetta Abbate elisabetta.abbate@stiima.cnr.it): optional, name and contact information of the organisation carrying out the underlying LCA study: STIIMA (Institute of Intelligent Industrial Technologies and Systems for Advanced Manufacturing)
Additional information: No Cut off rules have been applied. A quality check based on pedigree matrix has been applied. Allocations to PDT™ product are performed on a men-hours basis. Italian 2019 residual electricity mix (633 g CO_2eq/kWh) is used for Core processes, while European 2019 residual electricity mix (558 g CO_2eq/kWh) is used for Downstream processes.

Content declaration

Product

Materials / chemical substances	[kg]	%
Low-alloyed steel – Main components	18421.8	56.7
Cast iron – Main components	5349.4	16.5
Electric and electronic component	820.856	2.5
Cables, pipes, screws	882.756	2.7
Remaining components (mostly steel)	7028.963	21.6

All materials are in compliance with Regulation (EC) No 1907/2006 of the European parliament and of the council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Packaging

Distribution packaging: Depends on the end user location. If the end user is located out of Europe, sea transport is needed. In this case, packaging is mostly constituted by a wooden box and then by plastics.

Consumer packaging: Not applicable

Recycled material

Provenience of recycled materials (pre-consumer or post-consumer) in the product: no recycled materials in the product, no assumption on end-of-life recycling was applied

Environmental performance

Potential environmental impact

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	5.83E-01	1.95E-01	5.74E+00	6.52E+00
	Biogenic	kg CO_2 eq.	3.29E-02	3.44E-03	1.17E-01	1.54E-01
	Land use and land transformation	kg CO_2 eq.	2.54E-03	2.50E-04	8.90E-04	3.68E-03
	TOTAL	kg CO_2 eq.	6.19E-01	1.99E-01	5.86E+00	6.68E+00
Acidification potential (AP)		kg SO_2 eq.	4.88E-03	5.07E-04	3.18E-02	3.71E-02
Eutrophication potential (EP)		kg PO_4^{3-} eq.	2.26E-03	1.52E-04	1.31E-02	1.55E-02
Photochemical oxidant formation potential (POFP)		kg NMVOC eq.	2.82E-03	3.34E-04	1.72E-02	2.04E-02
Abiotic depletion potential – Elements		kg Sb eq.	7.81E-05	1.10E-06	8.82E-05	1.67E-04
Abiotic depletion potential – Fossil fuels		MJ, net calorific value	8.51E+00	3.16E+00	9.10E+01	1.03E+02
Water scarcity potential		m^3 eq.	2.82E+02	6.47E+00	3.31E+02	6.19E+02

Use of resources

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	1.33E-02	8.95E-02	3.02E+00	3.13E+00
	Used as raw materials	MJ, net calorific value	1.06E+00	8.73E-03	5.75E-01	1.64E+00
	TOTAL	MJ, net calorific value	1.07E+00	9.83E-02	3.60E+00	4.77E+00
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	3.88E-01	3.32E+00	1.44E+02	1.48E+02
	Used as raw materials	MJ, net calorific value	9.05E+00	8.12E-02	1.21E+01	2.12E+01
	TOTAL	MJ, net calorific value	9.44E+00	3.40E+00	1.56E+02	1.69E+02
Secondary material		kg	0.05794	7.50E-04	7.25E-03	6.59E-02
Renewable secondary fuels		MJ, net calorific value	INA	INA	INA	INA
Non-renewable secondary fuels		MJ, net calorific value	INA	INA	INA	INA
Net use of fresh water		m^3	6.56E+00	1.51E-01	7.70187	1.44E+01

Waste production and output flows

Waste production

PARAMETER	UNIT	Upstream	Core	Downstream	TOTAL
Hazardous waste disposed	**kg**	8.22E-05	3.41E-06	9.59E-05	1.81E-04
Non-hazardous waste disposed	**kg**	2.87E-01	5.23E-03	6.53E-01	9.45E-01
Radioactive waste disposed	**kg**	2.35E-05	4.47E-06	1.01E-03	1.04E-03

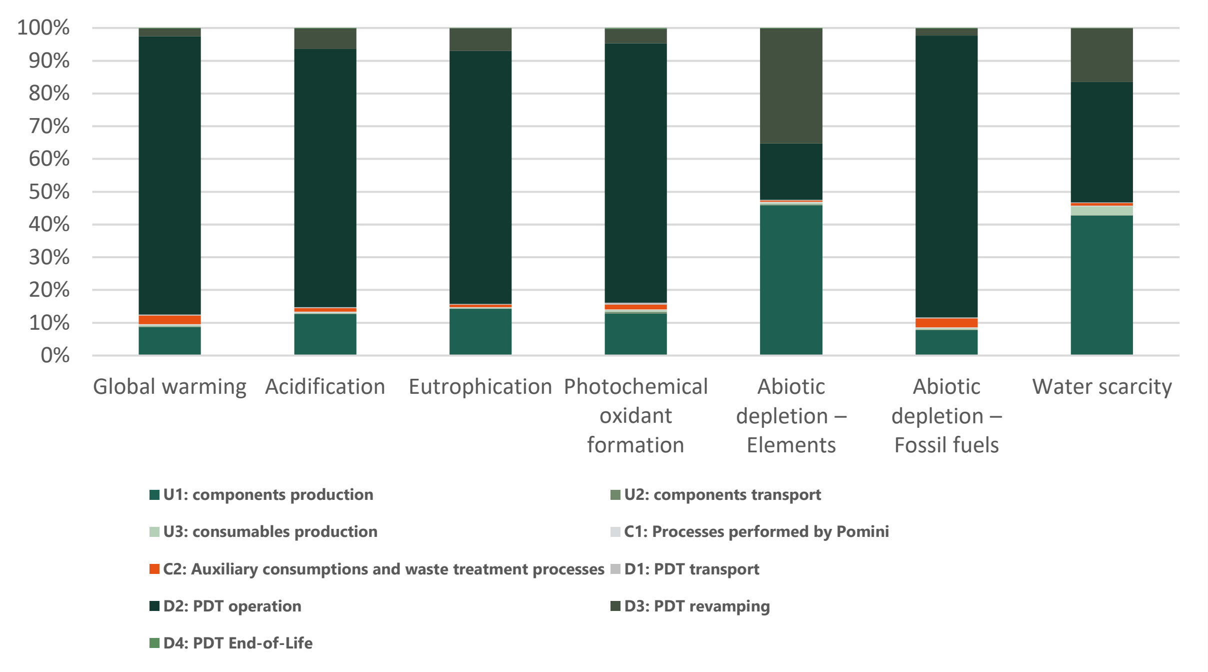
Output flows

PARAMETER	UNIT	TOTAL
Components for reuse	**kg**	INA
Material for recycling	**kg**	3.22E-03
Materials for energy recovery	**kg**	0
Exported energy, electricity	**MJ**	0
Exported energy, thermal	**MJ**	0

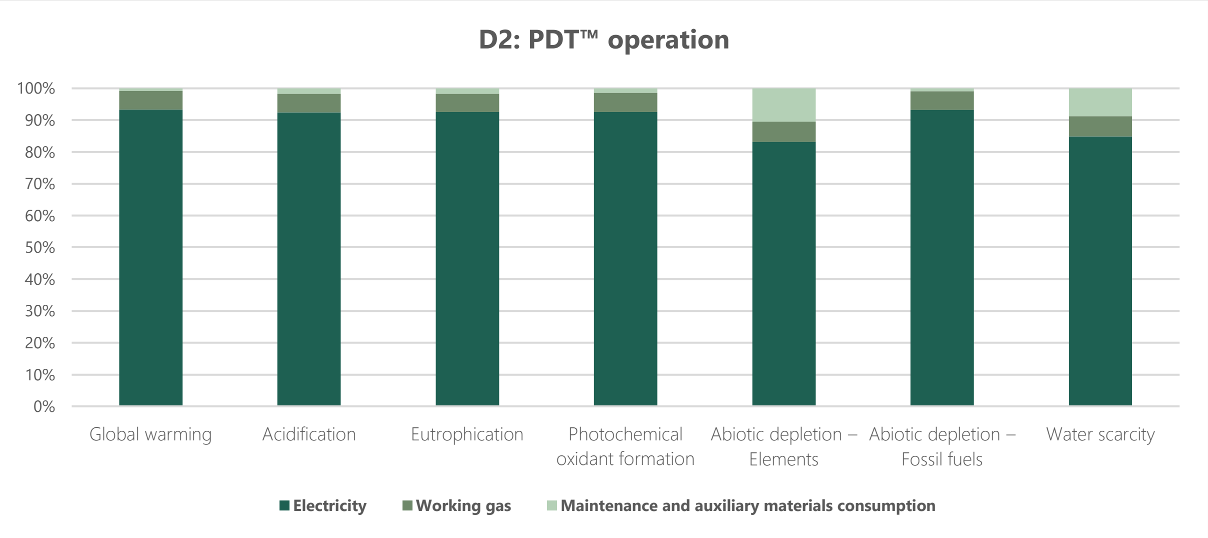
The LCI phases were divided into relevant categories for the PDT product results, with the U-phases belonging to the upstream part of the LCI, the C-phases belonging to the core part of the LCI and the D-phases belonging to the downstream part of the LCI:

- U1: Production of PDT™ components;
- U2: Transport of PDT™ components;
- U3: Production and transport of consumables;
- C1: Processes performed by Pomini;
- C2: Auxiliary consumptions and waste treatment processes;
- D1: PDT™ shipment;
- D2: PDT™ operation;
- D3: PDT™ revamping;
- D4: PDT™ End-of-life.

The D2 phase (PDT™ operation) constitutes the majority of impacts across all the analysed impact categories. Excluding the water scarcity category, the D2 phase constitutes the 65.7% of total impacts on average. For the water scarcity category, the D2 phase constitutes the 36.8% of total impacts. This is due to the employed electricity mix within this phase (European residual mix), which is only constituted by 0.75% electricity from hydro sources. Differently, the background processes of the other phases (apart from Core phases, which employ the residual electricity mix of Italy) do not employ residual mixes, therefore they consume a higher amount of electricity from hydro sources. The sum of upstream subphases contribute to 21.6% of total impacts on average, while D3 phase (Revamping) constitutes the 10.5% of total impacts on average.



Within the D2 phase (PDT™ operation), electricity supply constitutes the most relevant process, constituting the 90.3% of D2 phase impacts. Electricity and working gas share the same electricity provider (i.e. European residual electricity mix) and working gas impacts are mostly determined by the electricity provider.



Additional information

Tenova is engaged in an overriding commitment to environmental responsibility and actively pursue a balance between economic results, development of industrial capability and sustainability. Tenova constantly strives to minimize the environmental impact of its products, activities and operations wherever they may be in the world. R&D activities are driven by the target to reduce customers' environmental footprint (i.e. less pollution - NOx and CO2), while increasing energy-reuse, recycling and efficiency (i.e. less energy consumption, less raw material waste, cost reduction in production and increased plant efficiency). Tenova also promotes activities regarding its Sustainability objectives:

- Sustenovability is the name that Tenova gave to its future-forward commitment.
- Tenova is committed to embracing sustainability values in order to minimize the environmental impact for present and for future generations.
- Tenova issues policies, procedures, regulations and guidelines to better achieve its business purposes, following best practices and complying with regulations imposed by the various jurisdictions in which it conducts business.
- Tenova measures and reviews its HSE management and performance by means of regular audits and inspections, reporting progress to stakeholders, thereby ensuring continuous improvement and relevance.

Regarding the PDT™ machine, its design, fully enclosed for maximum operational safety, requires minimal maintenance, along with low energy consumption. Environmental value is provided by avoiding any toxic substances, and waste from processing materials. This breakthrough embodies the green commitments and principles *sustenovability* stands for, and looks like a vision to the eyes of stakeholders who place high value on sustainability concerns and expectations.
Most of the machine components are constituted by metals which can be recycled at the end-of-life of product.

References

General Programme Instructions of the International EPD® System. Version 4.0.

PCR 20xx:yy. MACHINE-TOOLS FOR WORKING MATERIALS BY REMOVAL OF MATERIAL, BY LASER OR SIMILAR PROCESSES. Draft version 1.0

Association of Issuing Bodies, European Residual Mixes 2019, URL: https://www.aib-net.org/facts/european-residual-mix

EUROPEAN INDUSTRIAL GASES ASSOCIATION AISBL, Benchmarking: Air Separation Plants and Indirect CO2 Emissions

Environmental performance – variation of number of active lasers

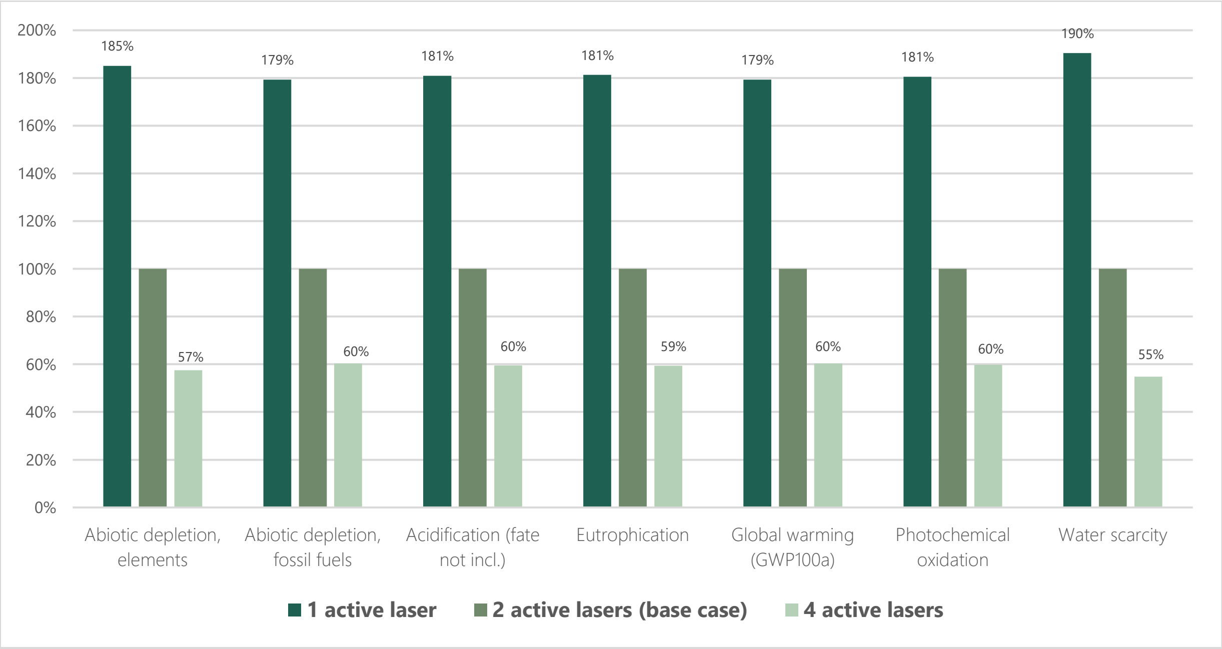
Potential environmental impact – 4 active lasers

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	2.94E-01	9.77E-02	3.55E+00	3.94E+00
	Biogenic	kg CO_2 eq.	1.66E-02	1.72E-03	7.19E-02	9.02E-02
	Land use and land transformation	kg CO_2 eq.	1.27E-03	1.20E-04	5.30E-04	1.92E-03
	TOTAL	kg CO_2 eq.	3.12E-01	9.95E-02	3.62E+00	4.03E+00
Acidification potential (AP)		kg SO_2 eq.	2.45E-03	2.53E-04	1.94E-02	2.21E-02
Eutrophication potential (EP)		kg PO_4^{3-} eq.	1.14E-03	7.68E-05	7.98E-03	9.20E-03
Photochemical oxidant formation potential (POFP)		kg NMVOC eq.	1.41E-03	1.67E-04	1.06E-02	1.21E-02
Abiotic depletion potential – Elements		kg Sb eq.	3.95E-05	5.51E-07	4.78E-05	8.78E-05
Abiotic depletion potential – Fossil fuels		MJ, net calorific value	4.29E+00	1.58E+00	5.62E+01	6.21E+01
Water scarcity potential		m^3 eq.	1.43E+02	3.24E+00	1.93E+02	3.39E+02

Potential environmental impact – 1 active laser

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	1.16E+00	3.91E-01	1.01E+01	1.17E+01
	Biogenic	kg CO_2 eq.	6.56E-02	6.88E-03	2.08E-01	2.80E-01
	Land use and land transformation	kg CO_2 eq.	5.08E-03	5.00E-04	1.62E-03	7.20E-03
	TOTAL	kg CO_2 eq.	1.23E+00	3.98E-01	1.03E+01	1.20E+01
Acidification potential (AP)		kg SO_2 eq.	9.73E-03	1.01E-03	5.64E-02	6.72E-02
Eutrophication potential (EP)		kg PO_4^{3-} eq.	4.52E-03	3.04E-04	2.33E-02	2.81E-02
Photochemical oxidant formation potential (POFP)		kg NMVOC eq.	5.61E-03	6.70E-04	3.05E-02	3.67E-02
Abiotic depletion potential – Elements		kg Sb eq.	1.53E-04	2.20E-06	1.72E-04	3.27E-04
Abiotic depletion potential – Fossil fuels		MJ, net calorific value	1.70E+01	6.32E+00	1.61E+02	1.84E+02
Water scarcity potential		m^3 eq.	5.60E+02	1.29E+01	6.06E+02	1.18E+03

For the sake of results interpretability, charts are here provided. Even if the number of active lasers concerns with the PDT™ operation, variations of this parameter changes the results of also Upstream and Core phases, as can be seen from the previous tables. Indeed, the total number of produced rolls changes with the analysed variable. According to our model, the number of working hours in one year is kept constant, but the cycle time doubles if the number of lasers is halved. Therefore, the total number of rolls machined across PDT™ useful life halves, too. This means that the Upstream and Core impacts per roll are doubled and quadrupled, respectively in the 2 lasers and 1 laser cases, with respect to the 4 lasers case.
Moreover, the downstream impacts show an increase too, which is due to the higher electricity consumption per machined roll. Indeed, if the number of active lasers is halved, the cycle time doubles, but the power consumption is not halved. Therefore, if the number of active lasers is halved, the electricity consumption per roll is almost doubled (it is not perfectly doubled due to a small power decrease related to the lower number of active lasers). Instead, working gas consumption per roll does not change with the number of active lasers. Indeed, if the number of active lasers is halved, the hourly gas consumption is halved too; but the cycle time is doubled, which eventually makes working gas consumption per roll remain stable across the analysed cases.
Results change in a similar way across impact categories, with an average increase of +310.8% in the 1 laser case, with respect to the 4 lasers case.



Environmental performance – variation of final user's location

Potential environmental impact – North America

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	5.83E-01	1.95E-01	5.79E+00	6.56E+00
	Biogenic	kg CO_2 eq.	3.29E-02	3.44E-03	2.37E-01	2.74E-01
	Land use and land transformation	kg CO_2 eq.	2.54E-03	2.50E-04	1.45E-02	1.73E-02
	TOTAL	kg CO_2 eq.	6.19E-01	1.99E-01	6.04E+00	6.86E+00
Acidification potential (AP)		kg SO_2 eq.	2.45E-03	2.53E-04	1.94E-02	2.21E-02
Eutrophication potential (EP)		kg PO_4^{3-} eq.	4.88E-03	5.07E-04	2.09E-02	2.63E-02
Photochemical oxidant formation potential (POFP)		kg NMVOC eq.	2.26E-03	1.52E-04	1.82E-02	2.06E-02
Abiotic depletion potential – Elements		kg Sb eq.	2.82E-03	3.34E-04	1.07E-02	1.38E-02
Abiotic depletion potential – Fossil fuels		MJ, net calorific value	7.81E-05	1.10E-06	9.11E-05	1.70E-04
Water scarcity potential		m^3 eq.	8.51E+00	3.16E+00	8.60E+01	9.77E+01

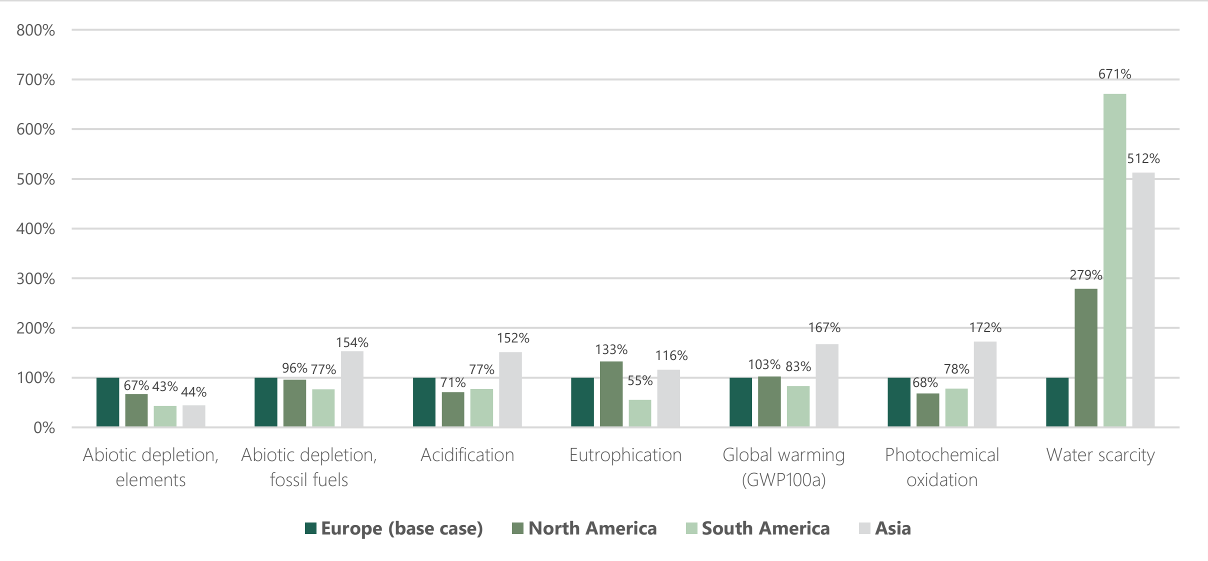
Potential environmental impact – South America

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	5.83E-01	1.95E-01	3.77E+00	4.55E+00
	Biogenic	kg CO_2 eq.	3.29E-02	3.44E-03	8.65E-01	9.02E-01
	Land use and land transformation	kg CO_2 eq.	2.54E-03	2.50E-04	1.06E-01	1.09E-01
	TOTAL	kg CO_2 eq.	6.19E-01	1.99E-01	4.74E+00	5.56E+00
Acidification potential (AP)		kg SO_2 eq.	4.88E-03	5.07E-04	2.32E-02	2.86E-02
Eutrophication potential (EP)		kg PO_4^{3-} eq.	2.26E-03	1.52E-04	6.16E-03	8.58E-03
Photochemical oxidant formation potential (POFP)		kg NMVOC eq.	2.82E-03	3.34E-04	1.26E-02	1.58E-02
Abiotic depletion potential – Elements		kg Sb eq.	7.81E-05	1.10E-06	8.66E-05	1.66E-04
Abiotic depletion potential – Fossil fuels		MJ, net calorific value	8.51E+00	3.16E+00	5.66E+01	6.83E+01
Water scarcity potential		m^3 eq.	2.82E+02	6.47E+00	3.87E+03	4.15E+03

Potential environmental impact – Asia

PARAMETER		UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	5.83E-01	1.95E-01	1.03E+01	1.11E+01
	Biogenic	kg CO_2 eq.	3.29E-02	3.44E-03	5.48E-02	9.12E-02
	Land use and land transformation	kg CO_2 eq.	2.54E-03	2.50E-04	4.45E-03	7.24E-03
	TOTAL	kg CO_2 eq.	6.19E-01	1.99E-01	1.04E+01	1.12E+01
Acidification potential (AP)		kg SO_2 eq.	4.88E-03	5.07E-04	5.09E-02	5.63E-02
Eutrophication potential (EP)		kg PO_4^{3-} eq.	2.26E-03	1.52E-04	1.56E-02	1.80E-02
Photochemical oxidant formation potential (POFP)		kg NMVOC eq.	2.82E-03	3.34E-04	3.19E-02	3.51E-02
Abiotic depletion potential – Elements		kg Sb eq.	7.81E-05	1.10E-06	9.19E-05	1.71E-04
Abiotic depletion potential – Fossil fuels		MJ, net calorific value	8.51E+00	3.16E+00	1.51E+02	1.63E+02
Water scarcity potential		m^3 eq.	2.82E+02	6.47E+00	2.88E+03	3.17E+03

For the sake of results interpretability, charts are here provided, but as can be seen from the previous tables, the only Downstream phase is affected by variations in the country of operation of PDT™. Residual mixes could not be employed for regions other than Europe, which is the reason behind the great variability shown by the water scarcity category. Indeed, the residual mix of Europe only employs 0.75% of electricity from hydro sources, which is the main driver of LCA results within this category. Within this analysis, variation of LCA results are only due to variations in Downstream phase results while the Upstream and Core phases remain equal across the different cases. Variations of LCA results are especially due to variations of D2 phase impacts, while the other subphases in the downstream phase (D1 and D3) are affected by different transport services, too, but the contribution of such services to total impacts remains low.



EPD®

www.environdec.com