EPD
Environmental Product Declaration

CONTROLLED ATMOSPHERE SINCE 1958

ADOX® N2
Air filtering machinery

Declaration in compliance with ISO 14025:2010	
Program Operator	EPDItaly
Publisher	EPDItaly
Declaration number	Isolcell 01_Rev. 01
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General information

Program Operator	EPDItaly Via Gaetano De Castillia 10, 20124 Milano (MI), Italia www.epditaly.it
EPD Owner	Isolcell S.p.A. Via A. Meucci 7, 39055 Laives (BZ) www.isolcell.com
Product	Air filtering machinery – ADOX® N2
UN CPC Code	43914 – Filtering or purifying machinery
Production Unit	Via A. Meucci 7, 39055 Laives (BZ)
Functional Unit	1 m^3 of air with 95% of N_2
Declared Unit	1 ADOX® N2 M2 unit
Independent verification	This declaration is in compliance with ISO 14025:2010 and Program Guidelines of EPDItaly, Revision 5.2 of 16.02.2022, without PCR. Independent external verification of the declaration and data, according to ISO 14025:2010. ☐ internal x external Verification performed by ICMQ S.p.A., Via Gaetano De Castillia 10, 20124 Milano (MI), Italia. Accredited by ACCREDIA.
Comparability	EPDs published within the same product category, but from different Program Operators, may not be comparable.
Responsibility	Isolcell S.p.A. relieves EPDItaly from any non-compliance with the environmental legislation self-declared by the manufacturer himself. The declaration Owner will be responsible for the information and supporting evidence; EPDItaly declines all responsibility regarding the manufacturer's information, data and results of the life cycle assessment.
Reference documents	EPD published in pre-certification in the absence of specific PCR. Program Guidelines of EPDItaly, Revision 5.2 of 16.02.2022.
Company contacts	Alessandro Altieri – Quality, Safety and Environment Manager T +39 0471 95 40 50 – isolcell@isolcell.com
Technical support	Development of Life Cycle Assessment and EPD Arch. Michele Paleari – michelepaleariarch@gmail.com

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CONTROLLED ATMOSPHERE SINCE 1958

INDUSTRY | STORAGE | CULTURAL HERITAGE | FIRE PREVENTION | OENOLOGY

Isolcell

Isolcell S.p.A. is the brand of Controlled Atmosphere.
The company was founded in 1958. Within the context of the Italian economic revolution, fond of new ways of living and investing, we decided to develop the Controlled Atmosphere technology to storage apples and pears produced in large quantities over our territory, the most important fruit production area in Europe. Since then, our progress evolved following the market trends.
From a small family business, we have become a structured modern company, and we are part of an industrial group named Finanziaria Unterland S.p.A. Today we are considered worldwide leaders in the industry of Modified and Controlled Generated Atmospheres. We have never stopped improving. From the traditional field of fruit and vegetables storage, our expertise has developed forward with innovative applications within the petroleum and gas, pharmaceutical, electronics, marine, heat treatment, and laser cutting industries. Moreover, within the detail-oriented field of artistic & historical heritage conservation, and pest control of food commodities. Innovation challenges are on-going: at Isolcell we are ready to embrace them and to go way beyond.

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We have always been focused on research & development. Each year a considerable part of our human resources and revenues are dedicated to studying and testing new products. This creative attitude is not limited to only one department. As a matter of fact, the constant will to solve problems in an inventive way is first of all a human behaviour. This is an open-minded approach which is confirmed by our results: more than 33 International patents and a constantly growing set of solutions admired on a worldwide scale.

We also collaborate with Universities and Research Centres on projects which end up generating practical solutions to be implemented immediately. On top of that, from the year 2000, we are certified as Research Laboratory recognized by the Ministry of University and Technological-Scientific Research.

Isolcell S.p.A. produces VPSA since 1994 and introduces the first low pressure and low energy consuming VSA (Vacuum Swing Adsorbtion) system. The new absorber ADOX® is being developed and patented (EP0880903-A1); it is the evolution of the VSA, a system that until today is unbeaten in its energy efficiency. Wherever the oxygen level needs to be lowered in conjunction with maximum efficiency ADOX® is the preferred solution.

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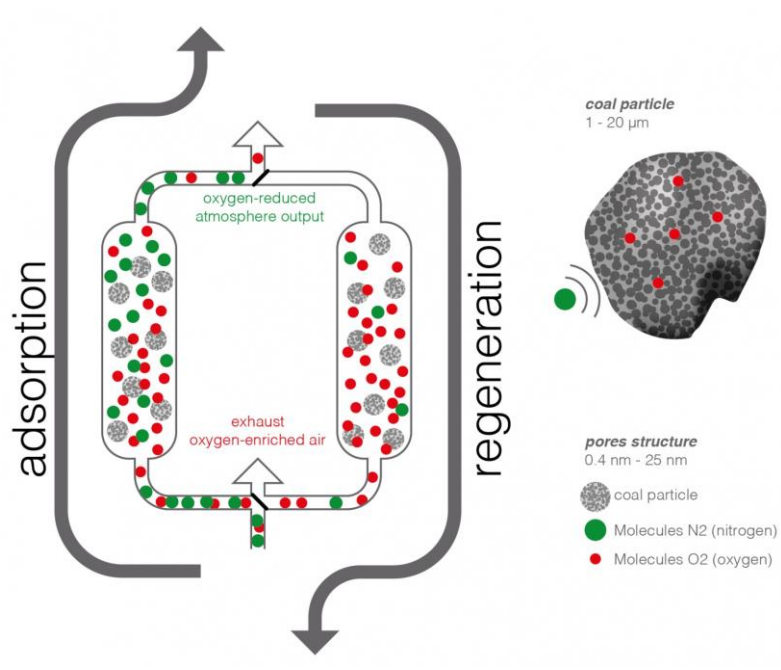
ADOX® N2

The ADOX® nitrogen generator can be used for the generation of nitrogen (air with low oxygen percentage) for fire prevention applications in the building sector.
Nitrogen generation takes place with VPSA (Vacuum-Pressure Swing Adsorption) technology, using two tanks filled with activated carbon. The machine is powered by a low-pressure compressor, a vacuum pump and, depending on the installation, by an external compressor or by the high-pressure line (max. 8 bar) for the control circuit. The compressor sends air (pressure approximately 1-1.5 bar) into one of the two tanks. These tanks are filled with CMS (Carbon Molecular Sieves) activated carbon, in the form of granules approximately 1-3 mm long, which separates the oxygen from the air flow.
Oxygen is accumulated on the surface of the activated carbon thanks to the chemical-physical phenomenon called adsorption. After approximately one minute, the carbon "saturates" with oxygen and is no longer able to adsorb, therefore it is "regenerated" by depressurizing the container and further emptying it with the vacuum pump. With this operation, the adsorbed oxygen is released from the carbon granules.



By using two containers that work alternately in "regeneration" and "adsorption" it is possible to guarantee a continuous flow of nitrogen to the process tank and therefore to the controlled environment.
Over the years, Isolcell S.p.A. has optimized the delicate filling process of the Carbon Molecular Sieves (CMS) into the cylinders. The system, based on several distinct operations and subsequent checks, allows the optimal and consistent filling of each individual cylinder while simultaneously solves the problem of mechanical wear over time as well as dust formation.

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ADOX® N2 output

The output generated by the ADOX® N2 is nitrogen for storage and fire prevention applications with a residual oxygen content obtainable between 5% and 10%.

ADOX® N2 characteristics

ADOX® N2 ORS was designed for heavy duty usage (24/7/365) being extremely moderate in energy consumption, thus being benchmark in its economy for nitrogen a self-producer. With the ADOX® VPSA low pressure technology operating with an average pressure of 1.2 bar(g) it is possible to eliminate high pressure compressors, thus significantly reducing energy and maintenance costs. Significant reduction of TCO (Total Cost of Ownership), achieved thanks to an accurate planning and to the selection of the best components with very low maintenance.
Therefore, the main advantages of ADOX® N2 are:

1. low operative energy consumption,
2. reduction of the maintenance costs.

ADOX® N2 Main sections

The machine ADOX® N2 consists of the following main units:

1. compressed air inlet group,
2. air/nitrogen separation group,
3. oxygen enriched air discharge/expulsion unit,
4. delivery group air depleted of oxygen (nitrogen),
5. control valve group,
6. nitrogen analysis group.

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ADOX® N2 modular concept and technical data

There are different sizes of ADOX® N2, designed on the basis of a concept of modularity, starting from a basic element; the combination of several modules allows maximum flexibility in the treatment of the required volumes of air. The M2 model was considered in the LCA study and in this EPD, as it is the most sold, both in single and multi-module configuration. The following Table no. 1 shows the characteristics of the ADOX® N2 M2 machine being evaluated, while Table no. 2 summarizes the differences of the other sizes compared to the M2 and Table no. 3 shows the main composition.

Table no. 1 – ADOX® N2 M2: technical data	
Commercial name	ADOX® N2 M2
Product description	Vacuum Pressure Swing Adsorption machine for controlled atmosphere with low oxygen content and high nitrogen content
Dimension	1400x1700x2250 mm
Weight	2.550 kg
Max pressure	1.6 bar(g)
Tanks	2
Installed power	16,0 kW
Average operating power	14,4 kW
Flow rate	90 m^2/h

Table no. 2 – ADOX® N2 M2: module comparison	
S1	Lower power and range, smaller modular structure
M1	Approximately 80% of components similar to M2 with smaller capacity
M2	**Under assessment**
L1	2 x M1 modules
L2	2 x M2 modules
XL1	3 x M2 modules with low-capacity compressor
XL2	3 x M2 modules

Table no. 3 – ADOX® N2 M2: main composition	
53%	Steel
22%	Electrical components: compressor, vacuum pump, fan, switches, cables
21%	Activated carbon
4%	Plastics, rubber and insulation

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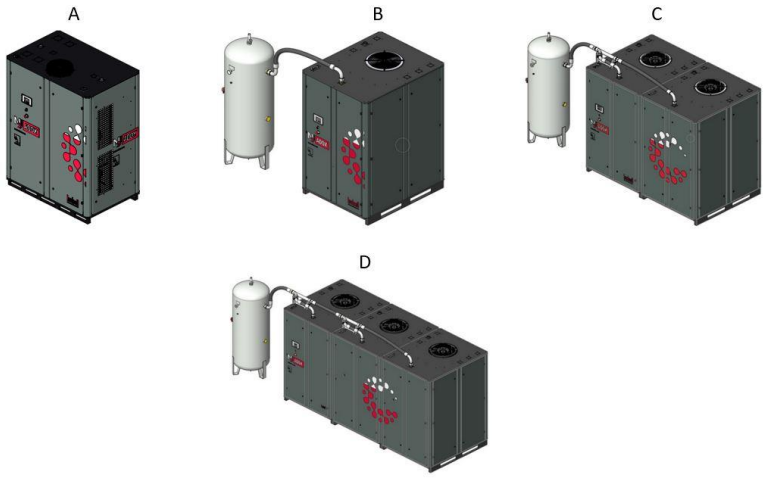
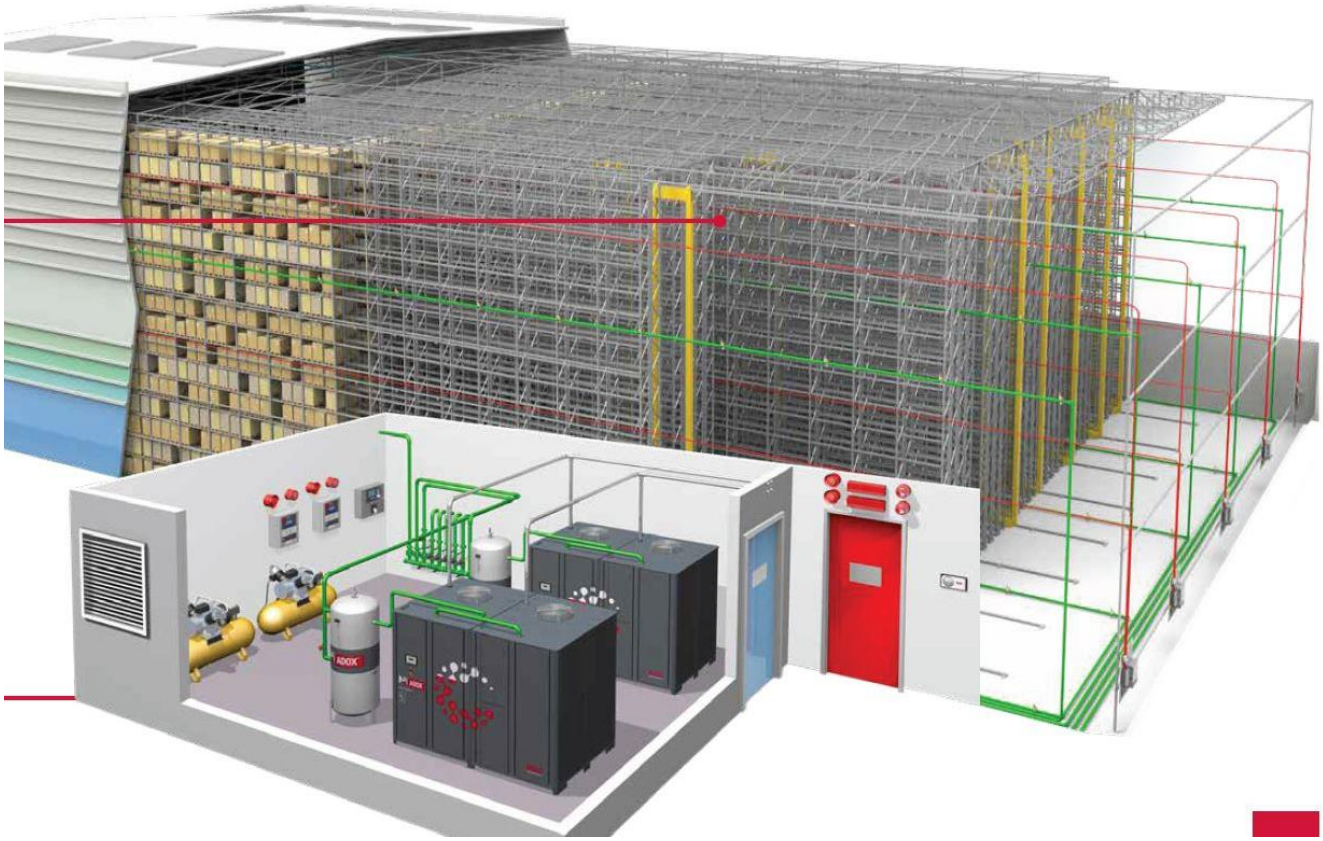
Therefore, the environmental profile of the M2 module is also representative of the L2, XL1 and XL2 modules and, with greater approximation, also of M1 and L1, since the main components consist of the steel structure, the coal tanks, the compressor and the vacuum pump, air circulation elements and electrical control components of the machine.



In the ADOX® N2 produced by Isolcell S.p.A. there are no substances of very high concern (SVHC) contemplated in the ECHA Candidate List in concentrations greater than 0.1%. The same products are not responsible for emissions of dangerous substances into air, water and soil, during the use phase.



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ADOX® N2 production process

The production phase, conducted by Isolcell S.p.A. at the Laives production unit, consists of assembling the components that make up the machine, filling the activated carbon tanks and testing the modules, before packing and shipping the product to the client. The activities are carried out manually or with the aid of small tools, therefore most of the electricity consumption comes from the setup and testing. On-site installation takes place through simple operations, since it is a plug and play device. In this phase, however, the electricity consumption due to commissioning is considered.

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Life Cycle Assessment

This Environmental Product Declaration and the Life Cycle Assessment on which it is based describe the environmental profile of the air filtering machinery ADOX® N2 under analysis, according to the *from cradle to grave* scenario. This scenario includes the stages of production (A1) and transport (A2) of the components and the production process in the Isolcell plant in Laives (A3), which are conducted directly by the manufacturer. Downstream of the plant gate, the phases of transport to the installation sites (A4), the installation (A5), the operational energy during use (B6) and the routine maintenance (B2) are also considered. The other phases of group B are included in the study but totally devoid of environmental relevance, since there are no replacement or refurbishment operations nor consumption of ancillary materials or water during use. The end-of-life phases are then included in the assessment, i.e. deinstallation of the machinery (C1), transport to the treatment centre (C2), processing of the waste for material recycling (C3), disposal of final waste (C4). The benefits achievable from the recovery and recycling processes of waste at the end of the product life (D) are not assessed.

UPSTREAM		CORE	DOWNSTREAM													
Manufacturing			Distribution Installation		Use stage							End-of-life stage				Resource recovery
Raw materials	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

MND: Module Not Declared.
EPD type: specific for the air filtering machinery under assessment.
Geographical area: Italy, according to production; worldwide, according to sale market conditions.
Reference year: 2021.
Software: SimaPro V. 9.4.
Database: Ecoinvent V. 3.8.
Functional unit: 1 m^3 of air with 95% of N_2.
Declared unit: 1 ADOX® N2 M2 unit.
Reference Service Life: 10 years.

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Environmental performances

The environmental performances of ADOX® N2 M2 are reported according to the Declared Unit. To obtain the environmental performances expressed according to the Functional Unit, the values have to be divided by 4,680,000 m^3 of filtered air produced during the useful life, according to the average operating scenario considered in the assessment.

	Parameters	Unit	Total A1-A3	A1	A2	A3	A4	A5	B2	B6	C2	C3	C4
Environmental impacts	GWP_{total}	kg CO_2 eq.	9,80 E+03	9,37 E+03	2,46 E+02	1,90 E+02	4,71 E+02	5,59 E+02	1,02 E+02	3,96 E+05	6,90 E+01	3,49 E+01	7,05 E+02
	GWP_{fossil}	kg CO_2 eq.	9,52 E+03	9,09 E+03	2,45 E+02	1,79 E+02	4,70 E+02	4,47 E+02	1,02 E+02	3,82 E+05	6,88 E+01	3,45 E+01	2,77 E+02
	$GWP_{biogenic}$	kg CO_2 eq.	2,71 E+02	2,59 E+02	4,57 E-01	1,16 E+01	7,38 E-01	1,12 E+02	6,62 E-01	1,32 E+04	2,03 E-01	3,69 E-01	4,27 E+02
	GWP_{luluc}	kg CO_2 eq.	1,20 E+01	1,17 E+01	1,24 E-01	1,87 E-01	2,36 E-01	9,20 E-01	5,49 E-02	7,97 E+02	4,26 E-02	5,90 E-02	9,63 E-03
	ODP	kg CFC-11 eq.	6,62 E-04	6,04 E-04	5,42 E-05	3,60 E-06	9,98 E-05	1,83 E-05	3,01 E-05	1,56 E-02	1,38 E-05	1,23 E-06	1,87 E-06
	AP	mol H+ eq.	1,10 E+02	1,07 E+02	3,23 E+00	2,05 E-01	5,57 E+00	2,29 E+00	6,89 E-01	1,97 E+03	2,60 E-01	4,99 E-01	1,69 E-01
	$EP_{freshwater}$	kg P eq.	9,50 E+00	9,47 E+00	1,33 E-02	1,69 E-02	2,98 E-02	3,19 E-01	2,31 E-02	2,76 E+02	6,91 E-03	2,95 E-02	2,21 E-02
	EP_{marine}	kg N eq.	1,23 E+01	1,14 E+01	8,18 E-01	1,01 E-01	1,41 E+00	4,40 E-01	7,07 E-02	3,58 E+02	6,57 E-02	4,27 E-02	1,06 E-01
	$EP_{terrestial}$	mol N eq.	1,40 E+02	1,31 E+02	9,05 E+00	6,32 E-01	1,56 E+01	3,96 E+00	2,10 E+00	3,37 E+03	7,16 E-01	4,93 E-01	7,46 E-01
	POCP	kg NMVOC eq.	5,05 E+01	4,79 E+01	2,45 E+00	1,75 E-01	4,27 E+00	1,10 E+00	7,98 E-01	9,13 E+02	2,28 E-01	1,37 E-01	1,95 E-01
	$ADP_{minerals\ and\ metals}$	kg Sb eq.	2,22 E+00	2,22 E+00	6,89 E-04	2,09 E-04	1,34 E-03	8,00 E-04	1,80 E-03	6,87 E-01	4,08 E-04	8,70 E-03	5,56 E-05
	ADP_{fossil}	MJ	1,14 E+05	1,09 E+05	3,53 E+03	7,82 E+02	6,68 E+03	7,50 E+03	1,93 E+03	6,48 E+06	9,85 E+02	4,25 E+02	1,64 E+02
	WDP	$m^3_{deprived}$ eq.	3,97 E+03	3,90 E+03	8,90 E+00	6,51 E+01	1,95 E+01	8,57 E+01	1,76 E+01	7,41 E+04	4,16 E+00	9,76 E+00	1,99 E+01

GWP = Global warming potential (total, fossil fuels, biogenic, land use and land use change); ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential (freshwater, marine, terrestrial); POCP = Formation potential of tropospheric ozone; $ADP_{minerals\ and\ metals}$ = Abiotic depletion potential for non-fossil resources; ADP_{fossil} = Abiotic depletion potential for fossil resources; WDP = Water user deprivation potential.
The results of the environmental impact indicators of $ADP_{minerals\ and\ metals}$, ADP_{fossil} and WDP shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.
The additional environmental impact indicators have been calculated for all the products, but not reported in the EPD.

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	Parameters	Unit	Total A1-A3	A1	A2	A3	A4	A5	B2	B6	C2	C3	C4
Resource use	PERE	MJ	3,73 E+04	3,70 E+04	4,24 E+01	2,83 E+02	6,92 E+01	1,12 E+03	5,81 E+01	9,69 E+05	1,61 E+01	5,78 E+01	5,36 E+00
	PERM	MJ	1,85 E+04	1,83 E+04	1,00 E+01	2,15 E+02	1,82 E+01	1,63 E+02	1,58 E+01	1,41 E+05	4,66 E+00	1,24 E+01	1,57 E+00
	PERT	MJ	5,58 E+04	5,53 E+04	5,24 E+01	4,98 E+02	8,75 E+01	1,28 E+03	7,39 E+01	1,11 E+06	2,07 E+01	7,02 E+01	6,93 E+00
	PENRE	MJ	1,21 E+05	1,17 E+05	3,74 E+03	8,40 E+02	7,09 E+03	7,91 E+03	2,05 E+03	6,84 E+06	1,05 E+03	4,52 E+02	1,77 E+02
	PENRM	MJ	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	PENRT	MJ	1,21 E+05	1,17 E+05	3,74 E+03	8,40 E+02	7,09 E+03	7,91 E+03	2,05 E+03	6,84 E+06	1,05 E+03	4,52 E+02	1,77 E+02
	SM	kg	3,33 E+02	3,33 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	RSF	MJ	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	NRSF	MJ	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	FW	m^3	1,02 E+02	9,97 E+01	3,14 E-01	1,53 E+00	5,97 E-01	5,06 E+00	5,33 E-01	4,38 E+03	1,22 E-01	2,81 E-01	6,03 E-01
	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water.												
Waste generated and output flows	HWD	kg	2,26 E+00	2,26 E+00	7,49 E-03	6,04 E-04	1,47 E-02	2,69 E-03	1,03 E-02	2,29 E+00	2,72 E-03	3,30 E-04	5,37 E-04
	NHWD	kg	2,37 E+03	2,22 E+03	1,32 E+02	1,56 E+01	2,60 E+02	3,01 E+01	8,17 E+00	2,55 E+04	3,18 E+01	5,31 E+00	2,92 E+01
	RWD	kg	2,68 E-01	2,42 E-01	2,40 E-02	1,80 E-03	4,42 E-02	4,22 E-02	1,02 E-02	3,65 E+01	6,12 E-03	1,29 E-03	5,21 E-04
	CRU	kg	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	MFR	kg	2,02 E+03	0,00 E+00	0,00 E+00	3,39 E+01	0,00 E+00	3,50 E+01	0,00 E+00	0,00 E+00	0,00 E+00	1,95 E+03	0,00 E+00
	MER	kg	5,30 E+02	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	5,30 E+02
	EEE	MJ	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	EET	MJ	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00	0,00 E+00
	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy.												

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Calculation rules

The environmental profile of ADOX® N2 M2 presented in this EPD is based on a Life Cycle Assessment, conducted according to the ISO 14040:2006, ISO 14044:2006, ISO 14025:2010 and EN 15804:2012+A2:2019 standards. Due to the absence of a specific PCR within EPDItaly, this EPD is published in pre-certification and the Life Cycle Assessment followed as reference documents some PCR for similar products, electric product and ICMQ-001/15 V. 3, for construction products. The LCA and the EPD are also in compliance with the Program Guidelines of EPDItaly, Revision 5.2 of 16.02.2022. The environmental analysis covers the entire life-cycle of the product, according to the *from cradle to grave* scenario, in which infrastructures, production plants and their maintenance are not considered.
The LCA study is based on primary data collected by Isolcell regarding the bill of materials, components characteristics, packaging materials, electrical energy, natural gas and water consumed in production, transport for components procurement and for finished product delivery to the clients; data about installation, operative energy consumption, routine maintenance, deinstallation and end-of-life scenario were also provided by the company. Ecoinvent V. 3.8 database was adopted to describe the processes for which primary data were not available; the LCA model was built with SimaPro V. 9.4 software in order to obtain the environmental results presented in this EPD.
Isolcell produces many series of filtering machinery with different characteristics but the assembly processes are similar and mainly carried out with manual operations; for this reason, the electricity consumptions for production, offices and general services, the natural gas consumption for heating and the water consumption for sanitary uses were allocated in linear way on the total production. The only production stage that absorbs electrical energy with specific consumption is the testing activity, which has different effects in relation to the type of machine being tested; that why, the specific consumption for the testing of each type of machine was deducted from the general consumption of the company before the linear allocation on the number of produced units.
According to the cut-off rules, only some minor components were excluded from the impact calculation and their relevance is 0.1% of ADOX® N2 total weight. Were also excluded the packaging of the minor components, the energy consumption for manual devices in installation and deinstallation, the production plant maintenance and the construction activities that sometime occur for preparing the installation site.

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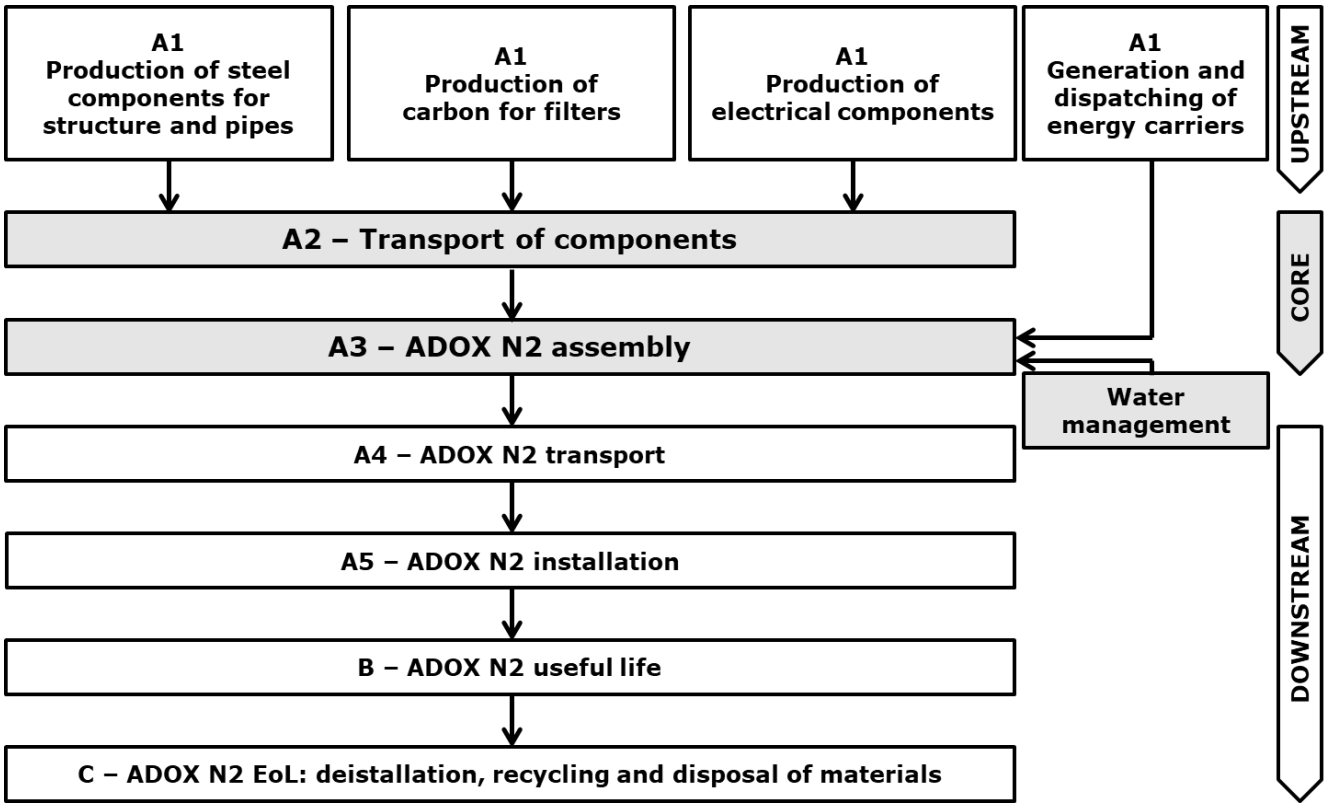
System boundaries

The system boundaries of the analysed process include all the phases from the procurement of components to the management of waste at the end of the product's life, with the subdivision into Upstream, Core and Downstream process. The Upstream phase (A1-A2) includes the activities of components production and the generation of the energy carriers. The Core process includes the components delivery to Isolcell site in Laives and the manufacturing, that is ADOX® N2 assembly and testing. The Downstream phase comprises the transport to the client, installation, use and maintenance, deinstallation and end-of-life scenarios of the product with the collection of waste materials to be sent to recycling process.



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Assumptions

ADOX® N2 marketing and installation

At the end of the production process, the product is marketed through a network of commercial branches, resellers and intermediaries operating on the Italian, European and world market, with specific relevance on the German one. Since the modules are produced on the basis of purchase orders, the transports from the production unit to the clients (A4) were evaluated according to the ADOX® N2 sold and installed in the reference year, with specific distances and means of transport.
Since the ADOX® N2 is a plug-in device, the on-site installation essentially involves manual operations; on the contrary, the pull down takes 60 hours on average and the specific electricity consumption was taken into consideration (A5).

ADOX® N2 use and maintenance

The use of ADOX® N2 involves only electricity consumption and its amount depends both on the machine setup and on the characteristics of the building where the device is installed. For the purposes of the evaluation (B6), an average usage scenario was considered for a reference service life of 10 years. The routine maintenance operations (B2) were taken into account, according to the maintenance manual; they consist in replacing the air filter of the compressor and the oil of both the compressor and the vacuum pump.

ADOX® N2 end of life

At the end of its useful life, the ADOX® N2 can be easily uninstalled and disassembled with manual operations and low electricity consumption, therefore this phase (C1) has been included in the present study but considered to have no impact due to the low relevance of energy consumption. Since the device can be completely disassembled, the materials of all components that belongs to the categories of steel, aluminium, brass, plastic materials and electrical components can be recovered and recycled (C3). Only the activated carbon must be sent for disposal in the incinerator and some small components will be landfilled (C4).

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ADOX® N2

Air filtering machinery