Type III Environmental Product Declaration No. 602/2024

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Underlay and top-cover membranes

Owner of the EPD:

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ITB is the verified member of The European Platform for EPD program operators and LCA practitioner www.eco-platform.org

Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804+A2 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment and their aspects verified by the independent body according to ISO 14025. Basically, comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804+A2.

Life cycle analysis (LCA): A1-A3, A4-A5 and D modules in accordance with EN 15804
(Cradle-to-Gate with options)

The year of preparing the EPD: 2024

Product standards: EN 13707:2004+A2:2009, EN 13969:2004, EN 13969:2004/A1:2006, EN 13970:2004, EN 13970:2004/A1:2006, EN 14967:2006, EN 13859-1:2010, EN 13967:2012, EN 14695:2010

Service Life: 50 years

PCR: ITB-PCR A

Declared unit: 1 m^2 (8 representative systems)

Reasons for performing LCA: B2B

Representativeness: Poland, 2023

MANUFACTURER

NEXLER Sp. z o.o. NEXLER is a Polish, dynamically developing company, whose origins date back to 1989. Since its inception, it has been engaged in the production of modern materials for water and moisture insulation. By introducing modern technologies and solutions to the market, it has become an expert in the field of the field of waterproofing and construction chemicals. As of June 30, 2023 it changed its name from Izohan to NEXLER.

Figure 1 The view of Nexler sp. z o.o.. manufacturing plant located in Gdańsk

NEXLER's origins date back to 1989, and it has been operating within the Atlas Group since 2006. The portfolio included five brands: IZOHAN, IZOLEX, IZOLMAT, NEXLER and IZOLMIX, now merged into one NEXLER. The integration of the brands has allowed the company to increase its offerings and expand its unique product and market development competencies within the Atlas Group. NEXLER has the broadest offering on the market for waterproofing materials, offering hundreds of system solutions to support contractors at every stage of an investment project. The company has two production facilities covered by this EPD: Production Plant in Gdańsk and in Jasło. The company's offer includes weldable top-cover membranes, weldable base membranes, special membranes, asphalt shingles, water and solvent-based bitumen, epoxy and polyurethane products, mineral-polymer products, as well as adhesives and sealants. The company is the first in Poland to have fine-particle technology, which is used in NEXLER's flagship products BITFLEX.

PRODUCTS DESCRIPTION

Manufactured membranes covered by this EPD are bituminous based products in rolls, created by assembling several components - in the form of the type and weight of the matrix (inlay), the type and amount of bituminous mass, the type and amount of surface finish. As a result of the assembly of the various elements, roofing membranes are created with different weights, thicknesses and performance characteristics that affect their application. EPD covers: mechanically fastened single-layer felts (modified), welded single-layer felts (modified), self-adhesive single-layer felts (modified), mechanically fastened two-layer felts (modified), welded two-layer felts (modified), self-adhesive two-layer felts (modified), mechanically fastened two-layer felts (oxidized) and welded two-layer felts oxidized. Inlay types and finishing's are provided in Table 1.

Table 1 Description of manufactured products

Inlay types	Types of bituminous compounds	Finishing method
Polyester 170 g/m^2	0°C bitumen compound	Fine sand sprinkle
Polyester 230 g/m^2	-5°C bitumen compound	Coarse sand sprinkling
Nonwoven polyester 115 g/m^2	-10°C bitumen compound	Fine natural slate (various colours)
Nonwoven polyester 120 g/m^2	-15°C bitumen compound	Coarse natural slate (various colours)
Nonwoven polyester 150 g/m^2	-20°C bitumen compound	Coloured basalt aggregate (various colours)
Nonwoven polyester 220 g/m^2	-25°C bitumen compound	HDPE film
Glass fabric 200 g/m^2	Self-adhesive compound	Siliconized film
Glass veil 60 g/m^2	Membrane compound	-
Glass veil 90 g/m^2	APP/IPP bitumen compound	-
Perforated veil	Green roof bitumen compound	-
Cardboard 220 g/m^2	Bridge membrane bitumen compound	-
Cardboard 300 g/m^2	-	-

All additional technical information about the product is available on the manufacturer's website and catalogues.

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Unit

The declared unit is 1 m^2 of product of statistically representative products (1-8 systems, Table 2.)

Table. 2. Systems covered by EPD

System no.	Layer	Type	Representative mass in kg/m^2
1	multi	self adhesive, modified	3.50
2	multi	mechanicaly fastened, modified	4.75
3	multi	mechanicaky fastened, oxidized	3.50
4	multi	torched, modified	5.50
5	multi	torched, oxidized	5.00
6	single	mechanicaly fastened, modified	3.50
7	single	self adhesive, modified	3.50
8	single	torched, modified	6.50

In order to convert the environmental impacts to 1 kg of specific product, the obtained results of the environmental impacts should be divided by mass in kg/m^2 for a selected system. In order to convert the environmental impacts to a different product's surface density, the obtained results should be divided by mass in kg/m^2 and multiplied by the specific mass in kg/m^2 of the selected specific product.

System boundary

The life cycle analysis of the declared products covers "Product Stage" A1-A3, A4-A5, C1-C4+D modules in accordance with EN 15804 and ITB PCR A (cradle to gate with options). Energy and water consumption, emissions as well as information on generated wastes were inventoried in Gdańsk and Jasło and were included in the calculation. This EPD is based on an LCA, in which 99,5 weight % has been accounted for. The packaging materials of incoming raw materials have been excluded. In accordance with EN 15804+A2, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA.

Allocation

The allocation rules used for this EPD are based on ITB PCR A and EN 15804+A2. Production of underlay and top-cover membranes is a line process conducted in NEXLER sp. z o.o. Allocation was done on product mass basis. All impacts associated with the extraction and processing of raw materials used for the production of underlay and top-cover membranes are allocated in module A1 of the LCA. Impacts from the global lines of production (Figure 2) were inventoried and 100% were allocated to underlay and top-cover membranes production. Water and energy consumption, associated emissions and generated wastes are allocated to module A3 Packaging materials were takien into consideration.

System limits

Type of the EPD is: cradle to gate - with options. The following life cycle stages were considered. Production stage including: A1 - Raw material extraction and processing, A2 - Transport to the manufacturer and A3 - Manufacturing, A4 - Transport to Site, A5 - Installation, End-of-life stage: C1 - Deconstruction, C2 - Transport to waste processing, C3 - Waste processing, C4 - Disposal (landfill). This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues. EPD includes D module- declaration of all benefits and loads beyond product system. Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included. It can be assumed that the total sum of omitted processes does not exceed 2% of all impact categories. 99.5% materials submitted for the formulations and production data were taken into consideration. In the assessment, all available data from production have been considered, i.e. all raw materials/elements used as per formulation process, utilized thermal energy for heating, and

electric power consumption. It can be assumed that the total sum of neglected processes does not exceed 0.5 % of energy use and mass per modules.

Modules A1 and A2: ***Raw materials supply and transport***

The modules A1 and A2 represent the extraction and processing of raw materials and components and transport to the production sites. Bitumen, sand, gravel, additives and packaging materials are sourced from domestic and foreign suppliers (ship and TIR). Means of transport include trucks (inventoried). Polish and European standards for average combustion were used for calculations. Data on mode of transport and distances, as reported by suppliers were used for those materials and parts contributing more than 0.1 % of total product mass. Module A1 comprises impacts from extraction and processing of raw materials including bitumen, SBS-polymer, reinforcements (polyester fiber, glass fiber), fillers, etc. The module also includes the production of purchased electricity and water used at 2 production sites.

Module A3: ***Production***

The production of underlay and top-cover membranes is carried out in NEXLER Sp. z o.o. in Gdańsk and Jasło (Poland). A scheme of the underlay and top-cover membranes production process by NEXLER Sp. z o.o. is presented in Fig. 2. The process of manufacturing bitumen roll products consists of applying asphalt paste to the matrix, finishing it on both sides according to the application, and cutting it into appropriate lengths and rolling it into a roll of the desired length. The process involves preparing the bitumen mass by mixing bitumen with polymers (styrene-butadiene-styrene copolymer in linear or radial form), with re-refined base oil at high temperature in a reactor and then with fillers (lime meal and fly ash) once. The composition of the asphalt paste depends on the properties of the final product - mainly on its flexibility at low temperature, determined by harmonized standards, which serve as the basis for marketing the product. In order to produce roofing membrane, an inlay in the form of a sheet about 1 m wide, made of various materials depending on the purpose of the roofing membrane and its desired properties, is fed to the production line. The inlay can be cardboard, polyester, non-woven polyester reinforced with fiberglass threads, glass fabric, veil or veil glued with a layer of aluminum. The different inlays differ primarily in their mechanical properties. Each material is properly conditioned (annealed) and then the matrix goes to impregnation (depending on the matrix), where it is pre-impregnated with bitumen to improve adhesion to the asphalt mass, which is important for the integrity of the entire product. The next step is the application of the bitumen mass, which is a key step in the entire production process. The bitumen mass, prepared in the reactor and mixer, is evenly applied to the matrix. The bitumen mass can be applied to different thicknesses - depending on the expected properties of the final product and ego destination. Subsequently, a top layer is placed on the roofing felt - depending on the product in the form of quartz sand or HDPE film (base membranes) or in the form of mineral sprinkles of various types, granulations and colors (top-cover membranes). The purpose of the mineral sprinkle on top of the roofing felt is to protect it from direct sunlight exposure to the surface of the felt and, as a result, extend its life. The bottom layer of the roofing felt is then finished in a similar manner, which is most often profiled (striped) to improve welding efficiency during application, and then cooled and covered with HDPE film. An alternative to this finishing method is sand sprinkling - in the case of membranes fixed only mechanically. The membrane is then cooled on a series of cooling rollers, then cut and rolled into rolls of the desired length. The roll can be protected from unrolling for transport with packing tapes or paper banding. The rolls are then stacked vertically on pallets, which are covered with shrink wrap and prepared for transport. There is also a group of special membranes that may contain additional elements or be constructed in a slightly different way, these products, however, are not described in the above description.

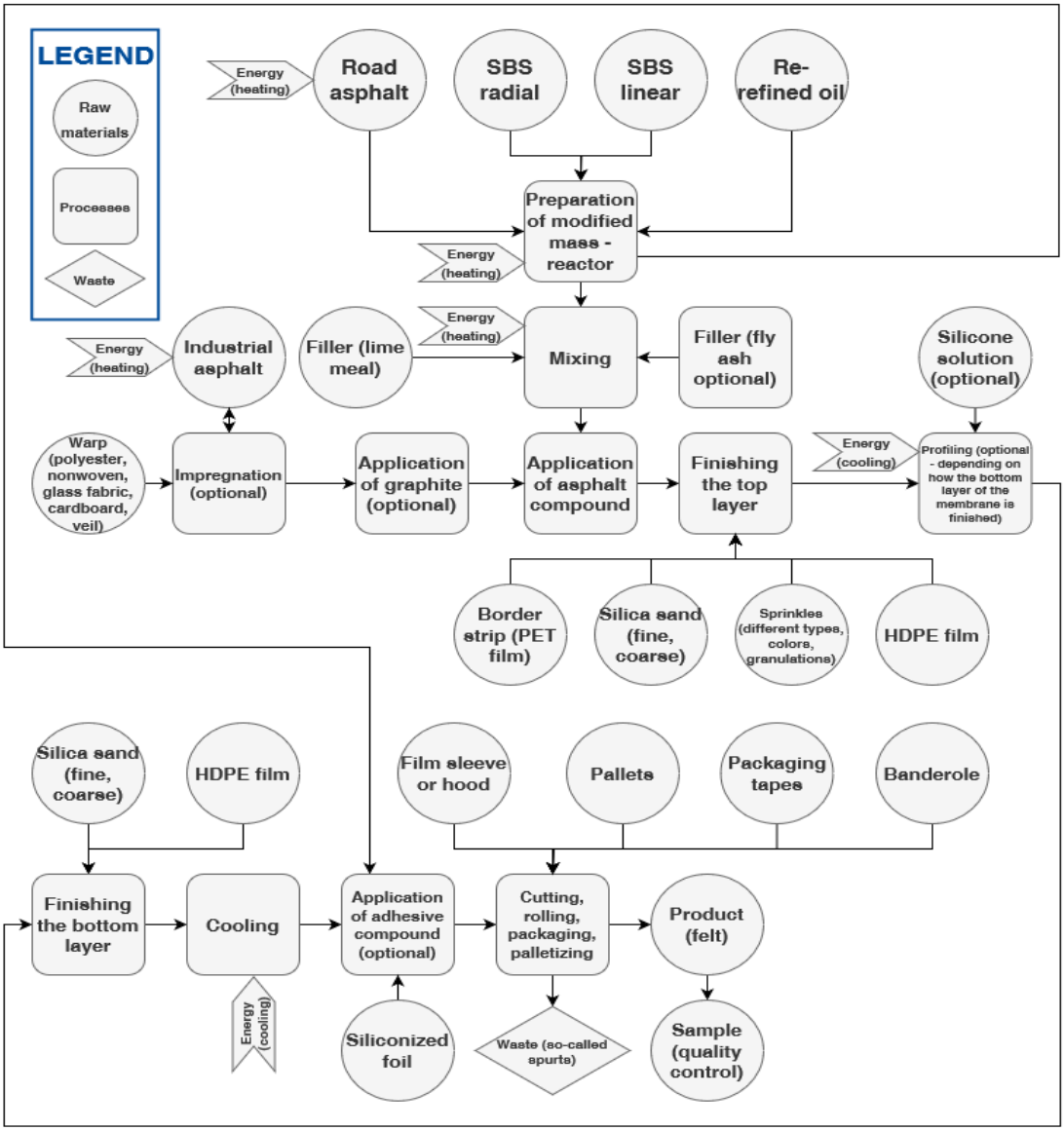

Figure 2 Manufacturing process scheme (A3)

Module A4: *Transport to a construction site*

The underlay and top-cover membranes produced are delivered to Polish as well as foreign customers. In the adapted scenario an average distance of 100 km from the factory gate to a recipient is assumed. Means of transport include 16-32t lorry (EURO 5) with fuel consumption of 35 l per 100 km.

Module A5: *Installation process*

In the adapted scenario the installation process requires application of heat flux in any form, most often it is a gas burner and other ancillary materials recommended by NEXLER sp. z o.o. The production and combustion of propane for torching and consumable materials have been included in the calculation. Underlay and top-cover membranes are attached to construction elements. Installation does not cause health or environmental hazards.

Modules B: Use stage

For the waterproofing solutions module B1 is not considered relevant. The product does not require any type of maintenance (B2) during its Reference Service Life. The product does not require any

type of repair (B3) during its Reference Service Life. The product does not require any replacement (B4) during its Reference Service Life. The product does not require any refurbishment (B5) during its Reference Service Life. The product does not require any energy consumption during its Reference Service Life and does not require any water consumption during its Reference Service Life (B5 and B6)

Modules *C and D: End-of-life (EOL)*

In the adapted scenario, dismantling of ceramic tiles (C1) is performed as part of building renovation or demolition processes, where environmental impacts from declared products can be considered as minor (<1%). There are no specific deconstruction methods, applied in Poland, in regards with the felt membrane so the hand tools and electric tools impact were assumed. De-construction of the bitumen membrane was assumed to be done with construction equipment which entails emissions from energy production and consumption. During the demolition process, all products are deposited as construction and demolition waste. Module C2 comprises impacts from transportation of the deconstructed products to waste processing (100 km). In the adapted scenario 10% of the membrane is forwarded to landfill in the form of mixed construction and demolition wastes. Ashes and other remains after C3 are reported in stage C4, this includes slag landfill and residual landfill.
Module C3 consists of the waste processing steps, that is re-melting recycling of the bitumen membrane at end-of-life. Emissions from this process are reported in module C3 and the benefits from heat and electricity generation are carried forward to module D. Environmental burdens declared in module C4 are associated with waste-specific emissions to air, soil and groundwater. Regarding the recycling material of metals, the metal parts in the EoL are declared as end-of-waste status.

Table 3. End-of-life scenario for the Uunderlay and top-cover membranes

Material	Material recovery	Recycling	Landfilling
Underlay and top-cover membranes	100%	90%	10%

Electricity at end-of-life (module C) has been modelled using an average Polish electricity mix as the location where the product reaches end-of-life is unknown.

Data collection period
The data for manufacture of the declared products refer to period between 01.01.2023 – 31.12.2023 (1 year). The life cycle assessments were prepared for Poland and Europe as reference area.

Data quality

The data selected for LCA originate from ITB-LCI questionnaires completed by NEXLER Sp. z o.o. and verified during data audit. No data collected is older than five years and no generic datasets used are older than ten years. The representativeness, completeness, reliability, and consistency are judged as good. The background data for the processes come from the following resources database Ecoinvent v.3.10 (asphalts, SBSs, sand, gravel, dolomite, graphite, potassium hydroxide, lime, basalt, polymers, paper, paraffin, packaging film, polyethylene, polypropylene, polystyrene, carton, styrene, butadiene, ethylvinylacetate, base oil, fly ash, glass fibre, PE fibre, water, bitumen adhesive, textiles, packing). Specific (LCI) data quality analysis was a part of the input data verification.

Assumptions and estimates

The impacts of the representative products were aggregated using weighted average.

Calculation rules
LCA was performed using ITB-LCA tool developed in accordance with EN15804+A2. Emission of greenhouse gases was calculated using the IPCC 2013 GWP method with a 100-year horizon. Emission of acidifying substances, Emission of substances to water contributing to oxygen depletion,

Emission of gases that contribute to the creation of ground-level ozone, Abiotic depletion, and ozone depletion emissions were all calculated with the CML-IA baseline method.

Additional information

Polish electricity (Ecoinvent v.3.10 supplemented by actual national KOBiZE data) emission factor used is 0.698kg CO_2/kWh. As a general rule, no particular environmental or health protection measures other than those specified by law are necessary. Underlay and top-cover membranes are inherently inert, chemically stable, and therefore do not emit pollutants and substances hazardous to the environment and health during use, such as VOCs and radon.

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) – 1 m^2 of membranes 1-8 systems produced in Poland. The following life cycle modules (Table 4) were included in the analysis. The following tables show the environmental impacts of the life cycle of selected modules (A1-A5+C1-C4+D) for each system.

Table 4 System boundaries for the environmental characteristic of the product.

Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction 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**
MD	**MD**	**MD**	**MD**	**MD**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MD**	**MD**	**MD**	**MD**	**MD**

Table 5 Life cycle assessment (LCA) results for System 1– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.10E+00	1.87E-01	1.16E+00	2.44E+00	5.84E-02	2.14E-01	2.38E-03	2.92E-02	8.54E-01	3.72E-03	-5.63E-01
Greenhouse potential - fossil	eq. kg CO_2	1.10E+00	1.86E-01	1.16E+00	2.44E+00	5.82E-02	2.13E-01	2.50E-03	2.91E-02	8.45E-01	3.68E-03	-6.08E-01
Greenhouse potential - biogenic	eq. kg CO_2	-1.99E-03	6.36E-04	3.30E-02	3.16E-02	1.99E-04	1.14E-03	-1.28E-04	9.94E-05	9.31E-03	3.72E-05	-4.54E-02
Global warming potential - land use and land use change	eq. kg CO_2	8.26E-04	7.31E-05	3.91E-04	1.29E-03	2.28E-05	4.17E-05	1.62E-05	1.14E-05	2.35E-04	3.73E-06	-1.15E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	3.89E-08	4.31E-08	2.87E-08	1.11E-07	1.35E-08	2.97E-08	2.36E-16	6.73E-09	2.34E-08	1.12E-09	-2.42E-08
Soil and water acidification potential	eq. mol H+	4.74E-03	7.56E-04	1.23E-02	1.78E-02	2.36E-04	4.79E-04	1.21E-05	1.18E-04	1.01E-03	3.11E-05	-2.49E-03
Eutrophication potential - freshwater	eq. kg P	2.04E-04	1.25E-05	2.10E-03	2.31E-03	3.91E-06	7.59E-06	8.57E-09	1.96E-06	4.66E-05	1.07E-06	-5.02E-03
Eutrophication potential - seawater	eq. kg N	9.65E-04	2.28E-04	1.85E-03	3.04E-03	7.13E-05	1.45E-04	5.65E-06	3.56E-05	3.44E-04	1.07E-05	-2.21E-03
Eutrophication potential - terrestrial	eq. mol N	1.03E-02	2.49E-03	1.51E-02	2.79E-02	7.78E-04	1.58E-03	6.26E-05	3.89E-04	3.48E-03	1.17E-04	-5.69E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	6.46E-03	7.62E-04	4.43E-03	1.17E-02	2.38E-04	5.04E-04	1.58E-05	1.19E-04	1.00E-03	3.37E-05	-3.76E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	2.55E-05	6.60E-07	5.43E-06	3.16E-05	2.06E-07	2.78E-07	2.42E-10	1.03E-07	3.30E-06	1.25E-08	-7.83E-06
Abiotic depletion potential - fossil fuels	MJ	2.95E+01	2.76E+00	1.94E+01	5.17E+01	8.63E-01	4.78E+00	3.15E-02	4.32E-01	2.24E+00	8.51E-02	-1.73E+01
Water deprivation potential	eq. m^3	2.93E-01	1.28E-02	4.02E-01	7.08E-01	3.99E-03	1.26E-02	2.69E-05	2.00E-03	1.39E-01	4.94E-04	-1.92E-01

Table 6 Life cycle assessment (LCA) results for System 1– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 7 Life cycle assessment (LCA) results for System 1– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.59E+00	3.96E-02	1.39E+00	3.01E+00	1.24E-02	1.46E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.37E+00
Consumption of renewable primary energy resources used as raw materials	MJ	1.92E-01	0.00E+00	0.00E+00	1.92E-01	0.00E+00	-2.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.18E-01
Total consumption of renewable primary energy resources	MJ	1.78E+00	3.96E-02	1.39E+00	3.21E+00	1.24E-02	1.25E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.89E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.59E+01	2.76E+00	1.87E+01	3.74E+01	8.64E-01	3.49E+00	3.17E-02	4.32E-01	-1.32E+02	0.00E+00	-8.87E+00
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.36E+01	0.00E+00	0.00E+00	1.36E+01	0.00E+00	1.43E+00	0.00E+00	0.00E+00	1.34E+02	0.00E+00	-8.43E+00
Total consumption of non-renewable primary energy resources	MJ	2.95E+01	2.76E+00	1.96E+01	5.19E+01	8.64E-01	4.91E+00	3.17E-02	4.32E-01	2.24E+00	9.20E-02	-1.73E+01
Consumption of secondary materials	kg	3.50E-01	9.26E-04	1.77E-03	3.53E-01	2.89E-04	1.17E-03	0.00E+00	1.45E-04	8.11E-03	0.00E+00	-6.42E-03
Consumption of renew. secondary fuels	MJ	6.24E-03	1.02E-05	9.66E-06	6.26E-03	3.19E-06	0.00E+00	0.00E+00	1.60E-06	1.05E-04	0.00E+00	-1.07E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	1.51E-02	1.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	9.90E-03	3.48E-04	8.58E-03	1.88E-02	1.09E-04	2.86E-04	2.52E-06	5.43E-05	2.79E-03	1.33E-05	-6.61E-03

Table 8 Life cycle assessment (LCA) results for System 1– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	4.89E-02	3.10E-03	5.35E-04	5.25E-02	9.69E-04	1.73E-10	1.67E-13	4.85E-04	3.08E-02	1.34E-07	-2.93E-01
Non-hazardous waste	kg	1.98E+00	5.51E-02	1.83E-02	2.05E+00	1.72E-02	4.70E-04	5.16E-06	8.60E-03	4.61E-01	3.51E-01	-2.23E+00
Radioactive waste	kg	1.46E-05	2.06E-07	1.47E-05	2.95E-05	6.45E-08	2.63E-06	5.88E-08	3.22E-08	9.93E-06	5.18E-07	-1.22E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	2.88E-04	8.56E-06	5.76E-03	6.06E-03	2.67E-06	6.93E-03	0.00E+00	1.34E-06	2.85E+00	0.00E+00	-2.44E-04
Materials for energy recovery	kg	2.26E-06	6.92E-08	1.71E-07	2.50E-06	2.16E-08	0.00E+00	0.00E+00	1.08E-08	8.14E-07	0.00E+00	-1.11E-06
Exported Energy	MJ	7,.27E-01	0.00E+00	5.65E-02	7.83E-01	0.00E+00	9.31E-02	0.00E+00	0.00E+00	3.47E+00	0.00E+00	-4.07E-01

Table 9 Life cycle assessment (LCA) results for System 2– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	7.43E-01	2.54E-01	1.57E+00	2.56E+00	7.93E-02	3.87E-01	3.24E-03	3.96E-02	1.16E+00	5.05E-03	-7.65E-01
Greenhouse potential - fossil	eq. kg CO_2	7.48E-01	2.53E-01	1.57E+00	2.57E+00	7.90E-02	3.85E-01	3.39E-03	3.95E-02	1.15E+00	5.00E-03	-8.25E-01
Greenhouse potential - biogenic	eq. kg CO_2	-5.22E-03	8.64E-04	4.48E-02	4.04E-02	2.70E-04	3.09E-03	-1.74E-04	1.35E-04	1.26E-02	5.04E-05	-6.17E-02
Global warming potential - land use and land use change	eq. kg CO_2	8.58E-04	9.92E-05	5.30E-04	1.49E-03	3.10E-05	1.13E-04	2.20E-05	1.55E-05	3.19E-04	5.07E-06	-1.56E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	3.10E-08	5.85E-08	3.90E-08	1.28E-07	1.83E-08	8.05E-08	3.20E-16	9.14E-09	3.17E-08	1.52E-09	-3.29E-08
Soil and water acidification potential	eq. mol H+	3.11E-03	1.03E-03	1.67E-02	2.09E-02	3.20E-04	1.30E-03	1.64E-05	1.60E-04	1.38E-03	4.22E-05	-3.38E-03
Eutrophication potential - freshwater	eq. kg P	1.53E-04	1.70E-05	2.85E-03	3.02E-03	5.31E-06	2.06E-05	1.16E-08	2.65E-06	6.33E-05	1.45E-06	-6.81E-03
Eutrophication potential - seawater	eq. kg N	7.08E-04	3.10E-04	2.51E-03	3.53E-03	9.67E-05	3.94E-04	7.66E-06	4.84E-05	4.67E-04	1.46E-05	-3.00E-03
Eutrophication potential - terrestrial	eq. mol N	7.54E-03	3.38E-03	2.05E-02	3.14E-02	1.06E-03	4.30E-03	8.50E-05	5.28E-04	4.72E-03	1.58E-04	-7.72E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	5.00E-03	1.03E-03	6.01E-03	1.20E-02	3.23E-04	1.37E-03	2.15E-05	1.62E-04	1.36E-03	4.58E-05	-5.11E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.80E-05	8.96E-07	7.38E-06	2.62E-05	2.80E-07	7.54E-07	3.29E-10	1.40E-07	4.47E-06	1.69E-08	-1.06E-05
Abiotic depletion potential - fossil fuels	MJ	2.16E+01	3.75E+00	2.64E+01	5.17E+01	1.17E+00	1.30E+01	4.28E-02	5.86E-01	3.04E+00	1.15E-01	-2.35E+01
Water deprivation potential	eq. m^3	3.00E-01	1.73E-02	5.46E-01	8.64E-01	5.42E-03	3.43E-02	3.65E-05	2.71E-03	1.88E-01	6.71E-04	-2.61E-01

Table 10 Life cycle assessment (LCA) results for System 2– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 2 Life cycle assessment (LCA) results for System 2– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.77E+00	5.38E-02	1.88E+00	3.70E+00	1.68E-02	3.97E-01	2.97E-03	8.41E-03	7.34E-01	2.03E-03	-1.86E+00
Consumption of renewable primary energy resources used as raw materials	MJ	2.60E-01	0.00E+00	0.00E+00	2.60E-01	0.00E+00	-5.86E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-7.03E-01
Total consumption of renewable primary energy resources	MJ	2.03E+00	5.38E-02	1.88E+00	3.96E+00	1.68E-02	3.38E-01	2.97E-03	8.41E-03	7.34E-01	2.03E-03	-2.57E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.04E+01	3.75E+00	2.54E+01	3.96E+01	1.17E+00	9.46E+00	4.30E-02	5.86E-01	-1.79E+02	0.00E+00	-1.20E+01
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.12E+01	0.00E+00	0.00E+00	1.12E+01	0.00E+00	3.88E+00	0.00E+00	0.00E+00	1.82E+02	0.00E+00	-1.14E+01
Total consumption of non-renewable primary energy resources	MJ	2.16E+01	3.75E+00	2.66E+01	5.19E+01	1.17E+00	1.33E+01	4.30E-02	5.86E-01	3.04E+00	1.25E-01	-2.35E+01
Consumption of secondary materials	kg	4.75E-01	1.26E-03	2.41E-03	4.79E-01	3.93E-04	3.18E-03	0.00E+00	1.96E-04	1.10E-02	0.00E+00	-8.71E-03
Consumption of renew. secondary fuels	MJ	8.14E-03	1.39E-05	1.31E-05	8.16E-03	4.33E-06	0.00E+00	0.00E+00	2.16E-06	1.42E-04	0.00E+00	-1.45E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	2.05E-02	2.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	1.04E-02	4.72E-04	1.16E-02	2.25E-02	1.47E-04	7.75E-04	3.43E-06	7.37E-05	3.79E-03	1.80E-05	-8.98E-03

Table 3 Life cycle assessment (LCA) results for System 2– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	3.08E-02	4.21E-03	7.26E-04	3.57E-02	1.32E-03	4.69E-10	2.27E-13	6.58E-04	4.19E-02	1.82E-07	-3.98E-01
Non-hazardous waste	kg	3.68E+00	7.47E-02	2.48E-02	3.78E+00	2.33E-02	1.28E-03	7.00E-06	1.17E-02	6.25E-01	4.76E-01	-3.02E+00
Radioactive waste	kg	1.58E-05	2.80E-07	2.00E-05	3.60E-05	8.75E-08	7.15E-06	7.98E-08	4.37E-08	1.35E-05	7.02E-07	-1.66E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	2.83E-04	1.16E-05	7.82E-03	8.11E-03	3.63E-06	1.88E-02	0.00E+00	1.81E-06	3.87E+00	0.00E+00	-3.31E-04
Materials for energy recovery	kg	1.12E-06	9.39E-08	2.33E-07	1.45E-06	2.93E-08	0.00E+00	0.00E+00	1.47E-08	1.10E-06	0.00E+00	-1.51E-06
Exported Energy	MJ	6.87E-01	0.00E+00	7.66E-02	7.64E-01	0.00E+00	2.53E-01	0.00E+00	0.00E+00	4.71E+00	0.00E+00	-5.52E-01

Table 13 Life cycle assessment (LCA) results for System 3– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	2.69E-01	1.87E-01	1.16E+00	1.61E+00	5.84E-02	2.14E-01	2.38E-03	2.92E-02	8.54E-01	3.72E-03	-5.63E-01
Greenhouse potential - fossil	eq. kg CO_2	2.81E-01	1.86E-01	1.17E+00	1.64E+00	5.82E-02	2.13E-01	2.50E-03	2.91E-02	8.45E-01	3.68E-03	6.08E-01
Greenhouse potential - biogenic	eq. kg CO_2	-1.33E-02	6.36E-04	3.30E-02	2.04E-02	1.99E-04	2.28E-03	-1.28E-04	9.94E-05	9.31E-03	3.72E-05	-4.54E-02
Global warming potential - land use and land use change	eq. kg CO_2	4.67E-04	7.31E-05	3.91E-04	9.31E-04	2.28E-05	8.35E-05	1.62E-05	1.14E-05	2.35E-04	3.73E-06	-1.15E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	1.26E-08	4.31E-08	2.87E-08	8.44E-08	1.35E-08	5.93E-08	2.36E-16	6.73E-09	2.34E-08	1.12E-09	-2.42E-08
Soil and water acidification potential	eq. mol H+	1.12E-03	7.56E-04	1.23E-02	1.42E-02	2.36E-04	9.59E-04	1.21E-05	1.18E-04	1.01E-03	3.11E-05	-2.49E-03
Eutrophication potential - freshwater	eq. kg P	5.15E-05	1.25E-05	2.10E-03	2.16E-03	3.91E-06	1.52E-05	8.57E-09	1.96E-06	4.66E-05	1.07E-06	-5.02E-03
Eutrophication potential - seawater	eq. kg N	2.86E-04	2.28E-04	1.85E-03	2.37E-03	7.13E-05	2.90E-04	5.65E-06	3.56E-05	3.44E-04	1.07E-05	-2.21E-03
Eutrophication potential - terrestrial	eq. mol N	3.10E-03	2.49E-03	1.51E-02	2.07E-02	7.78E-04	3.17E-03	6.26E-05	3.89E-04	3.48E-03	1.17E-04	-5.69E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	2.13E-03	7.62E-04	4.43E-03	7.32E-03	2.38E-04	1.01E-03	1.58E-05	1.19E-04	1.00E-03	3.37E-05	-3.76E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.42E-06	6.60E-07	5.43E-06	7.52E-06	2.06E-07	5.56E-07	2.42E-10	1.03E-07	3.30E-06	1.25E-08	-7.83E-06
Abiotic depletion potential - fossil fuels	MJ	8.60E+00	2.76E+00	1.94E+01	3.08E+01	8.63E-01	9.56E+00	3.15E-02	4.32E-01	2.24E+00	8.51E-02	-1.73E+01
Water deprivation potential	eq. m^3	9.60E-02	1.28E-02	4.02E-01	5.11E-01	3.99E-03	2.52E-02	2.69E-05	2.00E-03	1.39E-01	4.94E-04	-1.92E-01

Table 14 Life cycle assessment (LCA) results for System 3– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 15 Life cycle assessment (LCA) results for System 3– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	6.73E-01	3.96E-02	1.39E+00	2.10E+00	1.24E-02	2.92E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.37E+00
Consumption of renewable primary energy resources used as raw materials	MJ	1.92E-01	0.00E+00	0.00E+00	1.92E-01	0.00E+00	-4.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.18E-01
Total consumption of renewable primary energy resources	MJ	8.65E-01	3.96E-02	1.39E+00	2.29E+00	1.24E-02	2.49E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.89E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	3.96E+00	2.76E+00	1.87E+01	2.55E+01	8.64E-01	6.97E+00	3.17E-02	4.32E-01	-1.32E+02	0.00E+00	-8.87E+00
Consumption of non-renewable primary energy resources used as raw materials	MJ	4.64E+00	0.00E+00	0.00E+00	4.64E+00	0.00E+00	2.86E+00	0.00E+00	0.00E+00	1.34E+02	0.00E+00	-8.43E+00
Total consumption of non-renewable primary energy resources	MJ	8.60E+00	2.76E+00	1.96E+01	3.09E+01	8.64E-01	9.83E+00	3.17E-02	4.32E-01	2.24E+00	9.20E-02	-1.73E+01
Consumption of secondary materials	kg	1.75E-01	9.26E-04	1.77E-03	1.78E-01	2.89E-04	2.35E-03	0.00E+00	1.45E-04	8.11E-03	0.00E+00	-6.42E-03
Consumption of renew. secondary fuels	MJ	4.47E-03	1.02E-05	9.66E-06	4.49E-03	3.19E-06	0.00E+00	0.00E+00	1.60E-06	1.05E-04	0.00E+00	-1.07E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	1.51E-02	1.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	3.95E-03	3.48E-04	8.58E-03	1.29E-02	1.09E-04	5.71E-04	2.52E-06	5.43E-05	2.79E-03	1.33E-05	-6.61E-03

Table 16 Life cycle assessment (LCA) results for System 3– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	1.08E-02	3.10E-03	5.35E-04	1.44E-02	9.69E-04	3.45E-10	1.67E-13	4.85E-04	3.08E-02	1.34E-07	-2.93E-01
Non-hazardous waste	kg	9.56E-01	5.51E-02	1.83E-02	1.03E+00	1.72E-02	9.41E-04	5.16E-06	8.60E-03	4.61E-01	3.51E-01	-2.23E+00
Radioactive waste	kg	5.37E-06	2.06E-07	1.47E-05	2.03E-05	6.45E-08	5.27E-06	5.88E-08	3.22E-08	9.93E-06	5.18E-07	-1.22E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.12E-04	8.56E-06	5.76E-03	5.88E-03	2.67E-06	1.39E-02	0.00E+00	1.34E-06	2.85E+00	0.00E+00	-2.44E-04
Materials for energy recovery	kg	4.60E-07	6.92E-08	1.71E-07	7.01E-07	2.16E-08	0.00E+00	0.00E+00	1.08E-08	8.14E-07	0.00E+00	-1.11E-06
Exported Energy	MJ	3.38E-01	0.00E+00	5.65E-02	3.95E-01	0.00E+00	1.86E-01	0.00E+00	0.00E+00	3.47E+00	0.00E+00	-4.07E-01

Table 17 Life cycle assessment (LCA) results for System 4– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	3.18E+00	2.94E-01	1.82E+00	5.28E+00	9.18E-02	2.01E+00	3.75E-03	4.59E-02	1.34E+00	5.85E-03	-8.85E-01
Greenhouse potential - fossil	eq. kg CO_2	3.23E+00	2.93E-01	1.82E+00	5.34E+00	9.14E-02	2.00E+00	3.92E-03	4.57E-02	1.33E+00	5.79E-03	-9.55E-01
Greenhouse potential - biogenic	eq. kg CO_2	-5.82E-02	1.00E-03	5.18E-02	-5.42E-03	3.12E-04	1.07E-02	-2.01E-04	1.56E-04	1.46E-02	5.84E-05	-7.14E-02
Global warming potential - land use and land use change	eq. kg CO_2	2.41E-03	1.15E-04	6.14E-04	3.14E-03	3.59E-05	3.93E-04	2.55E-05	1.79E-05	3.69E-04	5.87E-06	-1.80E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	1.10E-07	6.77E-08	4.51E-08	2.23E-07	2.12E-08	2.80E-07	3.70E-16	1.06E-08	3.67E-08	1.76E-09	-3.80E-08
Soil and water acidification potential	eq. mol H+	1.23E-02	1.19E-03	1.94E-02	3.28E-02	3.71E-04	4.52E-03	1.90E-05	1.86E-04	1.59E-03	4.89E-05	-3.92E-03
Eutrophication potential - freshwater	eq. kg P	5.73E-04	1.97E-05	3.29E-03	3.89E-03	6.15E-06	7.16E-05	1.35E-08	3.07E-06	7.33E-05	1.68E-06	-7.89E-03
Eutrophication potential - seawater	eq. kg N	2.30E-03	3.58E-04	2.91E-03	5.57E-03	1.12E-04	1.37E-03	8.87E-06	5.60E-05	5.41E-04	1.68E-05	-3.48E-03
Eutrophication potential - terrestrial	eq. mol N	2.43E-02	3.91E-03	2.38E-02	5.19E-02	1.22E-03	1.49E-02	9.84E-05	6.11E-04	5.47E-03	1.83E-04	-8.94E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	1.61E-02	1.20E-03	6.96E-03	2.43E-02	3.74E-04	4.75E-03	2.48E-05	1.87E-04	1.58E-03	5.30E-05	-5.91E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.88E-05	1.04E-06	8.54E-06	2.83E-05	3.24E-07	2.62E-06	3.81E-10	1.62E-07	5.18E-06	1.96E-08	-1.23E-05
Abiotic depletion potential - fossil fuels	MJ	8.76E+01	4.34E+00	3.05E+01	1.22E+02	1.36E+00	4.51E+01	4.96E-02	6.78E-01	3.51E+00	1.34E-01	-2.72E+01
Water deprivation potential	eq. m^3	6.07E-01	2.01E-02	6.32E-01	1.26E+00	6.27E-03	1.19E-01	4.23E-05	3.14E-03	2.18E-01	7.77E-04	-3.02E-01

Table 18 Life cycle assessment (LCA) results for System 4– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 19 Life cycle assessment (LCA) results for System 4– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	3.10E+00	6.23E-02	2.18E+00	5.34E+00	1.95E-02	1.38E+00	3.43E-03	9.73E-03	8.50E-01	2.35E-03	-2.16E+00
Consumption of renewable primary energy resources used as raw materials	MJ	7.24E-01	0.00E+00	0.00E+00	7.24E-01	0.00E+00	-2.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-8.14E-01
Total consumption of renewable primary energy resources	MJ	3.82E+00	6.23E-02	2.18E+00	6.06E+00	1.95E-02	1.17E+00	3.43E-03	9.73E-03	8.50E-01	2.35E-03	-2.97E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	4.81E+01	4.34E+00	2.95E+01	8.19E+01	1.36E+00	3.29E+01	4.98E-02	6.78E-01	-2.07E+02	0.00E+00	-1.39E+01
Consumption of non-renewable primary energy resources used as raw materials	MJ	3.95E+01	0.00E+00	0.00E+00	3.95E+01	0.00E+00	1.35E+01	0.00E+00	0.00E+00	2.10E+02	0.00E+00	-1.32E+01
Total consumption of non-renewable primary energy resources	MJ	8.76E+01	4.34E+00	3.07E+01	1.23E+02	1.36E+00	4.63E+01	4.98E-02	6.78E-01	3.52E+00	1.45E-01	-2.72E+01
Consumption of secondary materials	kg	5.50E-01	1.46E-03	2.79E-03	5.54E-01	4.55E-04	1.11E-02	0.00E+00	2.27E-04	1.27E-02	0.00E+00	-1.01E-02
Consumption of renew. secondary fuels	MJ	1.56E-02	1.60E-05	1.52E-05	1.57E-02	5.01E-06	0.00E+00	0.00E+00	2.51E-06	1.64E-04	0.00E+00	-1.68E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	2.37E-02	2.37E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	1.86E-02	5.46E-04	1.35E-02	3.26E-02	1.71E-04	2.69E-03	3.97E-06	8.54E-05	4.38E-03	2.09E-05	-1.04E-02

Table 20 Life cycle assessment (LCA) results for System 4– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	1.47E-01	4.87E-03	8.41E-04	1.53E-01	1.52E-03	1.63E-09	2.63E-13	7.61E-04	4.85E-02	2.11E-07	-4.60E-01
Non-hazardous waste	kg	4.31E+00	8.65E-02	2.87E-02	4.42E+00	2.70E-02	4.44E-03	8.11E-06	1.35E-02	7.24E-01	5.51E-01	-3.50E+00
Radioactive waste	kg	3.22E-05	3.24E-07	2.31E-05	5.57E-05	1.01E-07	2.48E-05	9.24E-08	5.07E-08	1.56E-05	8.13E-07	-1.92E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	6.73E-04	1.34E-05	9.05E-03	9.74E-03	4.20E-06	6.53E-02	0.00E+00	2.10E-06	4.48E+00	0.00E+00	-3.84E-04
Materials for energy recovery	kg	8.57E-06	1.09E-07	2.69E-07	8.94E-06	3.40E-08	0.00E+00	0.00E+00	1.70E-08	1.28E-06	0.00E+00	-1.75E-06
Exported Energy	MJ	8.80E-01	0.00E+00	8.87E-02	9.68E-01	0.00E+00	8.78E-01	0.00E+00	0.00E+00	5.45E+00	0.00E+00	-6.39E-01

Table 21 Life cycle assessment (LCA) results for System 5– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	4.93E-01	2.67E-01	1.65E+00	2.41E+00	8.34E-02	1.83E+00	3.41E-03	4.17E-02	1.22E+00	5.32E-03	-8.05E-01
Greenhouse potential - fossil	eq. kg CO_2	4.71E-01	2.66E-01	1.65E+00	2.39E+00	8.31E-02	1.82E+00	3.57E-03	4.16E-02	1.21E+00	5.26E-03	-8.68E-01
Greenhouse potential - biogenic	eq. kg CO_2	2.11E-02	9.09E-04	4.71E-02	6.91E-02	2.84E-04	9.77E-03	-1.83E-04	1.42E-04	1.33E-02	5.31E-05	-6.49E-02
Global warming potential - land use and land use change	eq. kg CO_2	3.34E-04	1.04E-04	5.58E-04	9.97E-04	3.26E-05	3.58E-04	2.31E-05	1.63E-05	3.35E-04	5.33E-06	-1.64E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	1.77E-08	6.15E-08	4.10E-08	1.20E-07	1.92E-08	2.54E-07	3.37E-16	9.62E-09	3.34E-08	1.60E-09	-3.46E-08
Soil and water acidification potential	eq. mol H+	2.58E-03	1.08E-03	1.76E-02	2.13E-02	3.37E-04	4.11E-03	1.73E-05	1.69E-04	1.45E-03	4.44E-05	-3.56E-03
Eutrophication potential - freshwater	eq. kg P	9.51E-05	1.79E-05	3.00E-03	3.11E-03	5.59E-06	6.51E-05	1.22E-08	2.79E-06	6.66E-05	1.53E-06	-7.17E-03
Eutrophication potential - seawater	eq. kg N	6.28E-04	3.26E-04	2.64E-03	3.60E-03	1.02E-04	1.24E-03	8.06E-06	5.09E-05	4.91E-04	1.53E-05	-3.16E-03
Eutrophication potential - terrestrial	eq. mol N	6.88E-03	3.55E-03	2.16E-02	3.20E-02	1.11E-03	1.36E-02	8.95E-05	5.55E-04	4.97E-03	1.67E-04	-8.13E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	3.81E-03	1.09E-03	6.33E-03	1.12E-02	3.40E-04	4.32E-03	2.26E-05	1.70E-04	1.43E-03	4.82E-05	-5.37E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	2.58E-05	9.43E-07	7.76E-06	3.46E-05	2.95E-07	2.38E-06	3.46E-10	1.47E-07	4.71E-06	1.78E-08	-1.12E-05
Abiotic depletion potential - fossil fuels	MJ	1.23E+01	3.95E+00	2.78E+01	4.40E+01	1.23E+00	4.10E+01	4.51E-02	6.17E-01	3.20E+00	1.22E-01	-2.47E+01
Water deprivation potential	eq. m^3	2.12E-01	1.83E-02	5.75E-01	8.05E-01	5.70E-03	1.08E-01	3.84E-05	2.85E-03	1.98E-01	7.06E-04	-2.74E-01

Table 22 Life cycle assessment (LCA) results for System 5– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 23 Life cycle assessment (LCA) results for System 5– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.22E+00	5.66E-02	1.98E+00	3.25E+00	1.77E-02	1.25E+00	3.12E-03	8.85E-03	7.72E-01	2.14E-03	-1.96E+00
Consumption of renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.85E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-7.40E-01
Total consumption of renewable primary energy resources	MJ	1.22E+00	5.66E-02	1.98E+00	3.25E+00	1.77E-02	1.07E+00	3.12E-03	8.85E-03	7.72E-01	2.14E-03	-2.70E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	6.36E+00	3.95E+00	2.68E+01	3.71E+01	1.23E+00	2.99E+01	4.53E-02	6.17E-01	-1.88E+02	0.00E+00	-1.27E+01
Consumption of non-renewable primary energy resources used as raw materials	MJ	5.91E+00	0.00E+00	0.00E+00	5.91E+00	0.00E+00	1.22E+01	0.00E+00	0.00E+00	1.91E+02	0.00E+00	-1.20E+01
Total consumption of non-renewable primary energy resources	MJ	1.23E+01	3.95E+00	2.79E+01	4.42E+01	1.23E+00	4.21E+01	4.53E-02	6.17E-01	3.20E+00	1.31E-01	-2.47E+01
Consumption of secondary materials	kg	3.50E-01	1.32E-03	2.53E-03	3.54E-01	4.14E-04	1.01E-02	0.00E+00	2.07E-04	1.16E-02	0.00E+00	-9.17E-03
Consumption of renew. secondary fuels	MJ	3.31E-03	1.46E-05	1.38E-05	3.34E-03	4.56E-06	0.00E+00	0.00E+00	2.28E-06	1.49E-04	0.00E+00	-1.53E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	2.16E-02	2.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	7.79E-03	4.97E-04	1.23E-02	2.05E-02	1.55E-04	2.45E-03	3.61E-06	7.76E-05	3.99E-03	1.90E-05	-9.45E-03

Table 24 Life cycle assessment (LCA) results for System 5– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	2.00E-02	4.43E-03	7.65E-04	2.51E-02	1.38E-03	1.48E-09	2.39E-13	6.92E-04	4.41E-02	1.91E-07	-4.19E-01
Non-hazardous waste	kg	1.20E+00	7.86E-02	2.61E-02	1.30E+00	2.46E-02	4.03E-03	7.37E-06	1.23E-02	6.58E-01	5.01E-01	-3.18E+00
Radioactive waste	kg	9.24E-06	2.95E-07	2.10E-05	3.05E-05	9.21E-08	2.26E-05	8.40E-08	4.60E-08	1.42E-05	7.39E-07	-1.75E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.78E-04	1.22E-05	8.23E-03	8.42E-03	3.82E-06	5.94E-02	0.00E+00	1.91E-06	4.07E+00	0.00E+00	-3.49E-04
Materials for energy recovery	kg	3.86E-07	9.88E-08	2.45E-07	7.30E-07	3.09E-08	0.00E+00	0.00E+00	1.54E-08	1.16E-06	0.00E+00	-1.59E-06
Exported Energy	MJ	7.40E-01	0.00E+00	8.06E-02	8.20E-01	0.00E+00	7.98E-01	0.00E+00	0.00E+00	4.95E+00	0.00E+00	-5.81E-01

Table 25 Life cycle assessment (LCA) results for System 6– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	3.68E-01	1.87E-01	1.16E+00	1.71E+00	5.84E-02	2.85E-01	2.38E-03	2.92E-02	8.54E-01	3.72E-03	-5.63E-01
Greenhouse potential - fossil	eq. kg CO_2	4.73E-01	1.86E-01	1.16E+00	1.81E+00	5.82E-02	2.83E-01	2.50E-03	2.91E-02	8.45E-01	3.68E-03	-6.08E-01
Greenhouse potential - biogenic	eq. kg CO_2	-1.07E-01	6.36E-04	3.30E-02	-7.36E-02	1.99E-04	2.28E-03	-1.28E-04	9.94E-05	9.31E-03	3.72E-05	-4.54E-02
Global warming potential - land use and land use change	eq. kg CO_2	2.17E-03	7.31E-05	3.91E-04	2.63E-03	2.28E-05	8.35E-05	1.62E-05	1.14E-05	2.35E-04	3.73E-06	-1.15E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	1.84E-08	4.31E-08	2.87E-08	9.02E-08	1.35E-08	5.93E-08	2.36E-16	6.73E-09	2.34E-08	1.12E-09	-2.42E-08
Soil and water acidification potential	eq. mol H+	2.39E-03	7.56E-04	1.23E-02	1.55E-02	2.36E-04	9.59E-04	1.21E-05	1.18E-04	1.01E-03	3.11E-05	-2.49E-03
Eutrophication potential - freshwater	eq. kg P	1.27E-04	1.25E-05	2.10E-03	2.24E-03	3.91E-06	1.52E-05	8.57E-09	1.96E-06	4.66E-05	1.07E-06	-5.02E-03
Eutrophication potential - seawater	eq. kg N	6.05E-04	2.28E-04	1.85E-03	2.68E-03	7.13E-05	2.90E-04	5.65E-06	3.56E-05	3.44E-04	1.07E-05	-2.21E-03
Eutrophication potential - terrestrial	eq. mol N	6.22E-03	2.49E-03	1.51E-02	2.38E-02	7.78E-04	3.17E-03	6.26E-05	3.89E-04	3.48E-03	1.17E-04	-5.69E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	3.49E-03	7.62E-04	4.43E-03	8.68E-03	2.38E-04	1.01E-03	1.58E-05	1.19E-04	1.00E-03	3.37E-05	-3.76E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.16E-05	6.60E-07	5.43E-06	1.77E-05	2.06E-07	5.56E-07	2.42E-10	1.03E-07	3.30E-06	1.25E-08	-7.83E-06
Abiotic depletion potential - fossil fuels	MJ	1.22E+01	2.76E+00	1.94E+01	3.44E+01	8.63E-01	9.56E+00	3.15E-02	4.32E-01	2.24E+00	8.51E-02	-1.73E+01
Water deprivation potential	eq. m^3	2.36E-01	1.28E-02	4.02E-01	6.51E-01	3.99E-03	2.52E-02	2.69E-05	2.00E-03	1.39E-01	4.94E-04	-1.92E-01

Table 26 Life cycle assessment (LCA) results for System 6– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 27 Life cycle assessment (LCA) results for System 6– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	2.34E+00	3.96E-02	1.39E+00	3.76E+00	1.24E-02	2.92E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.37E+00
Consumption of renewable primary energy resources used as raw materials	MJ	1.15E+00	0.00E+00	0.00E+00	1.15E+00	0.00E+00	-4.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.18E-01
Total consumption of renewable primary energy resources	MJ	3.49E+00	3.96E-02	1.39E+00	4.92E+00	1.24E-02	2.48E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.89E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	6.81E+00	2.76E+00	1.87E+01	2.83E+01	8.64E-01	6.97E+00	3.17E-02	4.32E-01	-1.32E+02	0.00E+00	-8.87E+00
Consumption of non-renewable primary energy resources used as raw materials	MJ	5.44E+00	0.00E+00	0.00E+00	5.44E+00	0.00E+00	2.86E+00	0.00E+00	0.00E+00	1.34E+02	0.00E+00	-8.43E+00
Total consumption of non-renewable primary energy resources	MJ	1.23E+01	2.76E+00	1.96E+01	3.46E+01	8.64E-01	9.83E+00	3.17E-02	4.32E-01	2.24E+00	9.20E-02	-1.73E+01
Consumption of secondary materials	kg	2.45E-01	9.26E-04	1.77E-03	2.48E-01	2.89E-04	2.35E-03	0.00E+00	1.45E-04	8.11E-03	0.00E+00	-6.42E-03
Consumption of renew. secondary fuels	MJ	2.31E-02	1.02E-05	9.66E-06	2.31E-02	3.19E-06	0.00E+00	0.00E+00	1.60E-06	1.05E-04	0.00E+00	-1.07E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	1.51E-02	1.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	7.89E-03	3.48E-04	8.58E-03	1.68E-02	1.09E-04	5.71E-04	2.52E-06	5.43E-05	2.79E-03	1.33E-05	-6.61E-03

Table 28 Life cycle assessment (LCA) results for System 6– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	2.18E-02	3.10E-03	5.35E-04	2.54E-02	9.69E-04	3.45E-10	1.67E-13	4.85E-04	3.08E-02	1.34E-07	-2.93E-01
Non-hazardous waste	kg	1.10E+00	5.51E-02	1.83E-02	1.18E+00	1.72E-02	9.41E-04	5.16E-06	8.60E-03	4.61E-01	3.51E-01	-2.23E+00
Radioactive waste	kg	1.57E-05	2.06E-07	1.47E-05	3.06E-05	6.45E-08	5.27E-06	5.88E-08	3.22E-08	9.93E-06	5.18E-07	-1.22E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	3.65E-04	8.56E-06	5.76E-03	6.13E-03	2.67E-06	1.39E-02	0.00E+00	1.34E-06	2.85E+00	0.00E+00	-2.44E-04
Materials for energy recovery	kg	7.00E-07	6.92E-08	1.71E-07	9.41E-07	2.16E-08	0.00E+00	0.00E+00	1.08E-08	8.14E-07	0.00E+00	-1.11E-06
Exported Energy	MJ	6.76E-01	0.00E+00	5.65E-02	7.32E-01	0.00E+00	1.86E-01	0.00E+00	0.00E+00	3.47E+00	0.00E+00	-4.07E-01

Table 29 Life cycle assessment (LCA) results for System 7– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	7.38E-01	1.87E-01	1.16E+00	2.08E+00	5.84E-02	2.14E-01	2.38E-03	2.92E-02	8.54E-01	3.72E-03	-5.63E-01
Greenhouse potential - fossil	eq. kg CO_2	7.26E-01	1.86E-01	1.16E+00	2.07E+00	5.82E-02	2.13E-01	2.50E-03	2.91E-02	8.45E-01	3.68E-03	-6.08E-01
Greenhouse potential - biogenic	eq. kg CO_2	1.24E-02	6.36E-04	3.30E-02	4.60E-02	1.99E-04	1.14E-03	-1.28E-04	9.94E-05	9.31E-03	3.72E-05	-4.54E-02
Global warming potential - land use and land use change	eq. kg CO_2	3.96E-04	7.31E-05	3.91E-04	8.60E-04	2.28E-05	4.17E-05	1.62E-05	1.14E-05	2.35E-04	3.73E-06	-1.15E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	3.07E-08	4.31E-08	2.87E-08	1.03E-07	1.35E-08	2.97E-08	2.36E-16	6.73E-09	2.34E-08	1.12E-09	-2.42E-08
Soil and water acidification potential	eq. mol H+	2.81E-03	7.56E-04	1.23E-02	1.59E-02	2.36E-04	4.79E-04	1.21E-05	1.18E-04	1.01E-03	3.11E-05	-2.49E-03
Eutrophication potential - freshwater	eq. kg P	1.33E-04	1.25E-05	2.10E-03	2.24E-03	3.91E-06	7.59E-06	8.57E-09	1.96E-06	4.66E-05	1.07E-06	-5.02E-03
Eutrophication potential - seawater	eq. kg N	6.15E-04	2.28E-04	1.85E-03	2.69E-03	7.13E-05	1.45E-04	5.65E-06	3.56E-05	3.44E-04	1.07E-05	-2.21E-03
Eutrophication potential - terrestrial	eq. mol N	6.59E-03	2.49E-03	1.51E-02	2.42E-02	7.78E-04	1.58E-03	6.26E-05	3.89E-04	3.48E-03	1.17E-04	-5.69E-03
Potential for photochemical ozone synthesis	eq. kg NMVOC	4.72E-03	7.62E-04	4.43E-03	9.91E-03	2.38E-04	5.04E-04	1.58E-05	1.19E-04	1.00E-03	3.37E-05	-3.76E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.46E-05	6.60E-07	5.43E-06	2.07E-05	2.06E-07	2.78E-07	2.42E-10	1.03E-07	3.30E-06	1.25E-08	-7.83E-06
Abiotic depletion potential - fossil fuels	MJ	2.15E+01	2.76E+00	1.94E+01	4.37E+01	8.63E-01	4.78E+00	3.15E-02	4.32E-01	2.24E+00	8.51E-02	-1.73E+01
Water deprivation potential	eq. m^3	2.14E-01	1.28E-02	4.02E-01	6.29E-01	3.99E-03	1.26E-02	2.69E-05	2.00E-03	1.39E-01	4.94E-04	-1.92E-01

Table 30 Life cycle assessment (LCA) results for System 7– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 31 Life cycle assessment (LCA) results for System 7– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	9.56E-01	3.96E-02	1.39E+00	2.38E+00	1.24E-02	1.46E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.37E+00
Consumption of renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.18E-01
Total consumption of renewable primary energy resources	MJ	9.56E-01	3.96E-02	1.39E+00	2.38E+00	1.24E-02	1.25E-01	2.19E-03	6.19E-03	5.41E-01	1.49E-03	-1.89E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.00E+01	2.76E+00	1.87E+01	3.15E+01	8.64E-01	3.49E+00	3.17E-02	4.32E-01	-1.32E+02	0.00E+00	-8.87E+00
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.15E+01	0.00E+00	0.00E+00	1.15E+01	0.00E+00	1.43E+00	0.00E+00	0.00E+00	1.34E+02	0.00E+00	-8.43E+00
Total consumption of non-renewable primary energy resources	MJ	2.15E+01	2.76E+00	1.96E+01	4.39E+01	8.64E-01	4.91E+00	3.17E-02	4.32E-01	2.24E+00	9.20E-02	-1.73E+01
Consumption of secondary materials	kg	2.45E-01	9.26E-04	1.77E-03	2.48E-01	2.89E-04	1.17E-03	0.00E+00	1.45E-04	8.11E-03	0.00E+00	-6.42E-03
Consumption of renew. secondary fuels	MJ	1.65E-03	1.02E-05	9.66E-06	1.67E-03	3.19E-06	0.00E+00	0.00E+00	1.60E-06	1.05E-04	0.00E+00	-1.07E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	1.51E-02	1.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	6.95E-03	3.48E-04	8.58E-03	1.59E-02	1.09E-04	2.86E-04	2.52E-06	5.43E-05	2.79E-03	1.33E-05	-6.61E-03

Table 32 Life cycle assessment (LCA) results for System 7– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	2.83E-02	3.10E-03	5.35E-04	3.19E-02	9.69E-04	1.73E-10	1.67E-13	4.85E-04	3.08E-02	1.34E-07	-2.93E-01
Non-hazardous waste	kg	3.84E+00	5.51E-02	1.83E-02	3.91E+00	1.72E-02	4.70E-04	5.16E-06	8.60E-03	4.61E-01	3.51E-01	-2.23E+00
Radioactive waste	kg	1.25E-05	2.06E-07	1.47E-05	2.74E-05	6.45E-08	2.63E-06	5.88E-08	3.22E-08	9.93E-06	5.18E-07	-1.22E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.96E-04	8.56E-06	5.76E-03	5.96E-03	2.67E-06	6.93E-03	0.00E+00	1.34E-06	2.85E+00	0.00E+00	-2.44E-04
Materials for energy recovery	kg	1.13E-06	6.92E-08	1.71E-07	1.37E-06	2.16E-08	0.00E+00	0.00E+00	1.08E-08	8.14E-07	0.00E+00	-1.11E-06
Exported Energy	MJ	4.92E-01	0.00E+00	5.65E-02	5.49E-01	0.00E+00	9.31E-02	0.00E+00	0.00E+00	3.47E+00	0.00E+00	-4.07E-01

Table 33 Life cycle assessment (LCA) results for System 8– environmental impacts of (DU: 1 m^2)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	1.38E+00	3.47E-01	2.15E+00	3.87E+00	1.08E-01	1.83E+00	4.43E-03	5.42E-02	1.59E+00	6.92E-03	-1.05E+00
Greenhouse potential - fossil	eq. kg CO_2	1.35E+00	3.46E-01	2.15E+00	3.84E+00	1.08E-01	1.82E+00	4.64E-03	5.40E-02	1.57E+00	6.84E-03	-1.13E+00
Greenhouse potential - biogenic	eq. kg CO_2	2.91E-02	1.18E-03	6.13E-02	9.16E-02	3.69E-04	9.77E-03	-2.38E-04	1.85E-04	1.73E-02	6.90E-05	-8.44E-02
Global warming potential - land use and land use change	eq. kg CO_2	6.01E-04	1.36E-04	7.26E-04	1.46E-03	4.24E-05	3.58E-04	3.01E-05	2.12E-05	4.36E-04	6.93E-06	-2.13E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	5.94E-08	8.00E-08	5.33E-08	1.93E-07	2.50E-08	2.54E-07	4.38E-16	1.25E-08	4.34E-08	2.08E-09	-4.50E-08
Soil and water acidification potential	eq. mol H+	4.87E-03	1.40E-03	2.29E-02	2.91E-02	4.39E-04	4.11E-03	2.24E-05	2.19E-04	1.88E-03	5.77E-05	-4.63E-03
Eutrophication potential - freshwater	eq. kg P	2.18E-04	2.32E-05	3.89E-03	4.14E-03	7.26E-06	6.51E-05	1.59E-08	3.63E-06	8.66E-05	1.99E-06	-9.32E-03
Eutrophication potential - seawater	eq. kg N	9.90E-04	4.24E-04	3.44E-03	4.85E-03	1.32E-04	1.24E-03	1.05E-05	6.62E-05	6.39E-04	1.99E-05	-4.11E-03
Eutrophication potential - terrestrial	eq. mol N	1.06E-02	4.62E-03	2.81E-02	4.33E-02	1.44E-03	1.36E-02	1.16E-04	7.22E-04	6.46E-03	2.17E-04	-1.06E-02
Potential for photochemical ozone synthesis	eq. kg NMVOC	8.58E-03	1.42E-03	8.22E-03	1.82E-02	4.42E-04	4.32E-03	2.94E-05	2.21E-04	1.86E-03	6.27E-05	-6.99E-03
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	8.18E-06	1.23E-06	1.01E-05	1.95E-05	3.83E-07	2.38E-06	4.50E-10	1.92E-07	6.12E-06	2.32E-08	-1.45E-05
Abiotic depletion potential - fossil fuels	MJ	4.25E+01	5.13E+00	3.61E+01	8.38E+01	1.60E+00	4.10E+01	5.86E-02	8.02E-01	4.15E+00	1.58E-01	-3.21E+01
Water deprivation potential	eq. m^3	4.04E-01	2.37E-02	7.47E-01	1.17E+00	7.42E-03	1.08E-01	5.00E-05	3.71E-03	2.57E-01	9.18E-04	-3.57E-01

Table 34 Life cycle assessment (LCA) results for System 8– additional impacts indicators (DU: 1 m^2)

Indicator	Unit	A1-A3	A4-A5	C1-C4	D
Particulate matter	disease incidence	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA

Table 35 Life cycle assessment (LCA) results for System 8– the resource use (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.93E+00	7.36E-02	2.57E+00	4.57E+00	2.30E-02	1.25E+00	4.06E-03	1.15E-02	1.00E+00	2.78E-03	-2.55E+00
Consumption of renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.85E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-9.62E-01
Total consumption of renewable primary energy resources	MJ	1.93E+00	7.36E-02	2.58E+00	4.58E+00	2.30E-02	1.07E+00	4.06E-03	1.15E-02	1.00E+00	2.78E-03	-3.51E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.98E+01	5.13E+00	3.48E+01	5.97E+01	1.60E+00	2.99E+01	5.88E-02	8.02E-01	-2.44E+02	0.00E+00	-1.65E+01
Consumption of non-renewable primary energy resources used as raw materials	MJ	2.28E+01	0.00E+00	0.00E+00	2.28E+01	0.00E+00	1.22E+01	0.00E+00	0.00E+00	2.48E+02	0.00E+00	-1.57E+01
Total consumption of non-renewable primary energy resources	MJ	4.25E+01	5.13E+00	3.63E+01	8.40E+01	1.60E+00	4.21E+01	5.88E-02	8.02E-01	4.15E+00	1.71E-01	-3.21E+01
Consumption of secondary materials	kg	6.50E-02	1.72E-03	3.29E-03	7.00E-02	5.38E-04	1.01E-02	0.00E+00	2.69E-04	1.51E-02	0.00E+00	-1.19E-02
Consumption of renew. secondary fuels	MJ	4.34E-03	1.90E-05	1.79E-05	4.38E-03	5.92E-06	0.00E+00	0.00E+00	2.96E-06	1.94E-04	0.00E+00	-1.98E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	2.81E-02	2.81E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	1.50E-02	6.46E-04	1.59E-02	3.16E-02	2.02E-04	2.45E-03	4.69E-06	1.01E-04	5.18E-03	2.47E-05	-1.23E-02

Table 36 Life cycle assessment (LCA) results for System 8– waste categories (DU: 1 m²)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	5.04E-02	5.76E-03	9.94E-04	5.71E-02	1.80E-03	1.48E-09	3.11E-13	9.00E-04	5.73E-02	2.49E-07	-5.44E-01
Non-hazardous waste	kg	5.59E+00	1.02E-01	3.40E-02	5.73E+00	3.20E-02	4.03E-03	9.58E-06	1.60E-02	8.55E-01	6.52E-01	-4.13E+00
Radioactive waste	kg	1.90E-05	3.83E-07	2.73E-05	4.67E-05	1.20E-07	2.26E-05	1.09E-07	5.99E-08	1.84E-05	9.61E-07	-2.27E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	3.28E-04	1.59E-05	1.07E-02	1.10E-02	4.97E-06	5.94E-02	0.00E+00	2.48E-06	5.30E+00	0.00E+00	-4.53E-04
Materials for energy recovery	kg	2.44E-06	1.28E-07	3.18E-07	2.88E-06	4.02E-08	0.00E+00	0.00E+00	2.01E-08	1.51E-06	0.00E+00	-2.06E-06
Exported Energy	MJ	9.74E-01	0.00E+00	1.05E-01	1.08E+00	0.00E+00	7.98E-01	0.00E+00	0.00E+00	6.44E+00	0.00E+00	-7.56E-01

Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804 and ITB PCR A
Independent verification corresponding to ISO 14025 (sub clause 8.1.3.) [x] external [ ] internal
External verification of EPD: Halina Prejzner, PhD. Eng. LCI audit and verification: Michał Chwedaczuk, M.Sc. Eng. LCA, LCI audit and input data verification: Michał Piasecki, PhD., D.Sc., eng.

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Note 2: ITB is a public Research Organization and Notified Body (EC Reg. no 1488) to the European Commission and to other Member States of the European Union designated for the tasks concerning the assessment of building products' performance. ITB acts as the independent, third-party verification organization (ISO 17025/17065/17029). ITB-EPD program is recognized and registered member of The European Platform - Association of EPD program operators and ITB-EPD declarations are registered and stored in the international ECO-PORTAL.

Normative references

- ITB PCR A, V1.6 General Product Category Rules for Construction Products (2023)
- ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- PN-EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- KOBiZE Wskaźniki emisyjności CO_2, SO_2, NO_x, CO i pyłu całkowitego dla energii elektrycznej, grudzień 2023
- Ecoinvent.org

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CERTIFICATE № 602/2024
of TYPE III ENVIRONMENTAL DECLARATION

Products:

Underlay and top-cover membranes

Manufacturer:

NEXLER Sp. z o.o.
ul. Łużycka 6, 81-537 Gdynia, Poland

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

EN 15804+A2

Sustainability of construction works.
Environmental product declarations.
Core rules for the product category of construction products.

This certificate, issued on 8th March 2024 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Agnieszka Winkler-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, March 2024