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Arhitektonski fakultet
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Faculty of Architecture



Zero
Emission
Buildings **nZEB**



REPUBLIKA HRVATSKA
Ministarstvo prostornoga
uređenja, graditeljstva i
državne imovine

AGC
Your Dreams, Our Challenge



BOSCH
Tehnologija za život

knaufinsulation



Kömmerling KBE

Wienerberger

baldini studio

MG
Nosivi građevinski elementi d.o.o.

VELUX®

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Zero
Emission
Buildings

nZEB

Knauf Insulation
proizvodi kao temelj
ostvarenja zgrada nulte
emisije

Silvio Novak, dipl.ing.građ.
Žan Aleksander Božić, dipl.oecc.



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**baldinī
studīe**

NIG
Nosivi građevinski elementi d.o.o.

VELUX®



- toplinska, zvučna i protupožarna izolacija
- sustavi
- alati za projektiranje i energetsko certificiranje

Tehnički propis o racionalnoj uporabi energije i toplinskoj zaštiti u zgradama
("Narodne novine" broj 128/15, 70/18, 73/18, 86/18, 102/20)

Pravilnik o energetskom pregledu zgrade i energetskom certificiranju
("Narodne novine" broj 88/17, 90/20, 1/21, 45/21)

Tablica 8. – Najveće dopuštene vrijednosti za nove zgrade (nZEB) grijane i/ili hlađene na temperaturu 18 °C ili višu

ZAHTJEVI ZA NOVE ZGRADE	Q ⁿ _{H,nD} [kWh/(m ² ·a)]						E _{prim} [kWh/(m ² ·a)]					
	nZEB			nZEB			nZEB			nZEB		
	kontinent, θ _{mm} ≤ 3 °C		primorje, θ _{mm} > 3 °C		kont θ _{mm} ≤ 3 °C		prim θ _{mm} > 3 °C		kont θ _{mm} ≤ 3 °C		prim θ _{mm} > 3 °C	
VRSTA ZGRADE	f ₀ ≤ 0,20	0,20 < f ₀ < 1,05	f ₀ ≥ 1,05	f ₀ ≤ 0,20	0,20 < f ₀ < 1,05	f ₀ ≥ 1,05	f ₀ ≤ 0,20	0,20 < f ₀ < 1,05	f ₀ ≥ 1,05	f ₀ ≤ 0,20	0,20 < f ₀ < 1,05	f ₀ ≥ 1,05
Višestambena	40,50	32,39 + 40,58·f ₀	75,00	24,84	19,86 + 24,89·f ₀	45,99	80	50				
Obiteljska kuća	40,50	32,39 + 40,58·f ₀	75,00	24,84	17,16 + 38,42·f ₀	57,50	45	35				
Uredska	16,94	8,82 + 40,58·f ₀	51,43	16,19	11,21 + 24,89·f ₀	37,34	35	25				
Obrazovna	11,98	3,86 + 40,58·f ₀	46,48	9,95	4,97 + 24,91·f ₀	31,13	55	55				
Bolnica	18,72	10,61 + 40,58·f ₀	53,21	46,44	41,46 + 24,89·f ₀	67,60	250	250				
Hotel i restoran	35,48	27,37 + 40,58·f ₀	69,98	11,50	6,52 + 24,89·f ₀	32,65	90	70				
Sportska dvorana	96,39	88,28 + 40,58·f ₀	130,89	37,64	32,66 + 24,91·f ₀	58,82	210	150				
Trgovina	48,91	40,79 + 40,58·f ₀	83,40	13,90	8,92 + 24,91·f ₀	35,08	170	150				
Ostale nestambene	40,50	32,39 + 40,58·f ₀	75,00	24,84	19,86 + 24,89·f ₀	45,99	/	/				

Tablica 2. Energetski razred grafički se prikazuje na energetskom certifikatu zgrade slovom (A+, A, B, C, D, E, F, G) s podatkom o specifičnoj godišnjoj primarnoj energiji, E_{prim} izraženoj u kWh/m²a.

E _{prim} (kWh/m ² a)	STAMBENA		OBITELJSKA		UREDSKA		OBRAZOVNA		BOLNICA		HOTEL I RESTORAN		SPORTSKA DVORANA		TRGOVINA		OSTALE NESTAMBENE	
	K	P	K	P	K	P	K	P	K	P	K	P	K	P	K	P	K	P
A+	≤ 80	≤ 50	≤ 45	≤ 35	≤ 35	≤ 25	≤ 55	≤ 55	≤ 250	≤ 250	≤ 90	≤ 70	≤ 210	≤ 150	≤ 170	≤ 150	≤ 80	≤ 50
A	<100	<75	<80	<55	<55	<50	<60	<58	<275	<275	<110	<75	<305	<160	<310	<210	<115	<75
B	>100	>75	>80	>55	>55	>50	>60	>58	>275	>275	>110	>75	>305	>160	>310	>210	>115	>75
C	≤120	≤90	≤115	≤70	≤70	≤70	≤65	≤60	≤300	≤300	≤130	≤80	≤400	≤170	≤450	≤280	≤150	≤100
D	>120	>90	>115	>70	>70	>70	>65	>60	>300	>300	>130	>80	>400	>170	>450	>280	>150	>100
E	≤265	≤220	≤280	≤230	≤100	≤90	≤125	≤120	≤345	≤325	≤160	≤95	≤465	≤225	≤475	≤290	≤280	≤225
F	>265	>220	>280	>230	>100	>90	>125	>120	>345	>325	>160	>95	>465	>225	>475	>290	>280	>225
G	<410	<350	<445	<385	<125	<110	<175	<175	<395	<350	<190	<110	<530	<280	<495	<340	<410	<350

K- kontinentalna Hrvatska;
P- primorska Hrvatska

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→ ZEB jesmo li spremni?



A što ako je Eprim < 0 (kWh a; kWh/m²)(Proizvodnja veća od potrošnje) ?

Rezultati proračuna potrebine topilinske energije za grijanje i topilinske energije za hlađenje			
Osyeži satni proračun			
A [m ²]	721,99	[o m ⁻¹]	0,93
Ak [m ²]	180,24	Ak' [m ²]	180,24
Ve [m ³]	777,80		
Q _{H,nf} [kWh/a]	5685,57		
Q [*] H,nf [kWh/m ² a]	31,54	Q [*] H,nf (max) [kWh/m ² a]	32,04
Q _{C,nf} [kWh/a]	8969,01		ZADOVOLJAVA
Q [*] C,nf [kWh/m ² a]	49,76	Q [*] C,nf (max) [kWh/m ² a]	50,00
E _H [kWh/a]	-16972,03		ZADOVOLJAVA
E [*] Ae [kWh/m ² a]	94,16		
E _{pot} [kWh/a]	27392,86		
E [*] prin [kWh/m ² a]	-151,98	E [*] prin (max) [kWh/m ² a]	150,00
H _{U,sd} [W/m ² K]	0,51	H _{U,sd} (max) [W/m ² K]	0,61
H _{U,sd} [W/K]	371,51		ZADOVOLJAVA
H _{s,sd} [W/K]	70,11		
Q _I [kWh]	25673,47	Q _s [kWh]	26708,38
Q _I [kWh]	9473,42	Q _s [kWh]	36181,79



ENERGETSKI RAZRED?

ENERGETSKI RAZREDI ZGRADE	Specifična godišnja potrebita topilinska energija za grijanje $\alpha_{H,nf}$ [kWh/(m ² a)]	Specifična godišnja primarna energija E_{prim} [kWh/(m ² a)]
A+	A+ 13,83	A+ -153,15
A		
B		
C		
D		
E		
F		
G		
Upisati „nZEB“ ako zgrada zadovoljava zahtjeve za zgrade gotovo nulte energije propisane važećim TPRUETZ ¹ . Pojedinačno zaštiti kulturno dobro/unutar zaštić. kult.- povjes. cjeline		
nZEB		
Ne		
Specifična godišnja emisija CO ₂ [kg/(m ² a)] ¹	0,00	0 25 50 75 100 125 150 175 >200

Poštovani,

Kao što smo i ranije naveli, sustav IEC za sada ne poznaje negativne vrijednosti ili nulu - mora biti upisana minimalna pozitivna vrijednost, a to je 0,01 da bi se mogao izračunati energetski razred i spremiti promjene.

Dakle, nema nove XSD sheme, nego vaš računalni program kad šalje podatke u IEC umjesto negativne vrijednosti treba slati najmanju pozitivnu vrijednost (zato je i prijedlog 0,01).

Nova direktiva predviđa i mogućnost dodatne energije te će se zgrade koje proizvode više energije nego što potroše svrstavati u neki A+ razred, i ta će promjena utjecati na novi način certificiranja i prilagodbu IEC-a, ali do donošenja nove direktive sustav se neće mijenjati.

Srdačan pozdrav,



REPUBLIKA HRVATSKA
Ministarstvo prostornoga
uređenja, graditeljstva
i državne imovine

Uprava za energetsku učinkovitost u zgradarstvu,
projekte i programe Europske unije
Sektor za energetska učinkovitost u zgradarstvu
t: +38513782170
e: infoiec@mpgi.hr
Ulica Republike Austrije 14 | 10000 Zagreb
www.mgipu.hr

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Compromise amendment 1: supported by EPP, S&D, Renew, Greens/EFA, The Left

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on the energy performance of buildings (recast)

(Text with EEA relevance)

- (7) Buildings *and building elements and materials* are responsible for greenhouse gas emissions before, during and after their operational lifetime. The whole life-cycle emissions of buildings should therefore progressively be taken into account, *in line with a Union methodology to be established by the Commission, starting with new, then renovated buildings, for which Member States should establish whole life-cycle greenhouse gas emission reduction targets in accordance with that Union methodology.*

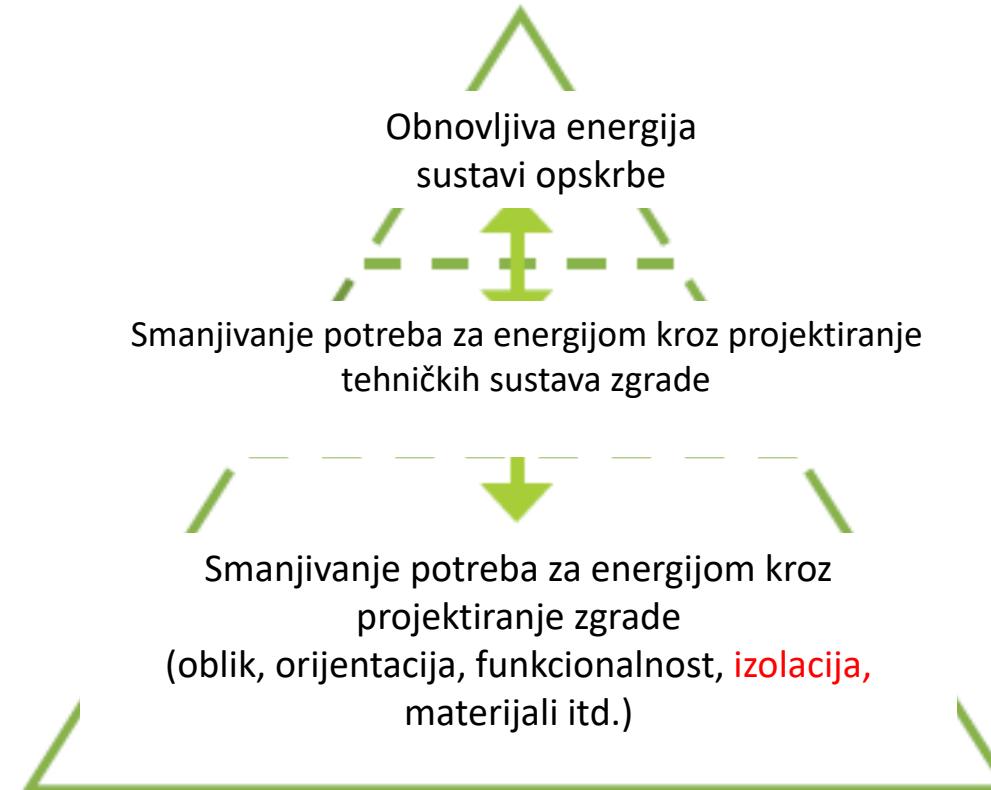
Buildings are a significant material bank, being repositories for resources over many decades, and the design options largely influence the whole life-cycle emissions both for new buildings and renovations. The whole life-cycle performance of buildings should be taken into account not only in new construction, but also in renovations through the inclusion of policies *and* reduction *targets* of whole life-cycle greenhouse gas emissions in Member States' building renovation plans.



19. ‘deep renovation’ means a renovation *in line with the energy efficiency first principle and efforts to reduce whole life-cycle greenhouse gas emissions generated during the renovation*, which, focusses on *essentials building items such as: wall insulation, roof insulation, low floor insulation, replacement of external joinery, ventilation and heating or heating systems and treatment of thermal bridges to ensure the necessary comfort of the occupants in summer and winter or a renovation resulting in the reduction of at least 60% primary energy demand for worst-performing buildings for which it is technically and economically not feasible to achieve a ZEB standard*, transforms a building or building unit
- (a) before 1 January **2027**, into a nearly zero-energy building;
 - (b) **from** 1 January **2027**, into a zero-emission building;



Osnovni koncept/strategija za postizanje uvjeta nZEB/ZEB





ZEB – uvjeti?

ZEB – Zero Energy Buildings

ZAHTJEVI ZA NOVE ZGRADE	$Q''_{H,nd}$ [kWh/(m ² ·a)]						E_{prim} [kWh/(m ² ·a)]	
	nZEB						ZEB	
	kontinent, $\theta_{mm} \leq 3^{\circ}C$			primorje, $\theta_{mm} > 3^{\circ}C$			kont $\theta_{mm} \leq 3^{\circ}C$	prim $\theta_{mm} > 3^{\circ}C$
VRSTA ZGRADE	$f_0 \leq 0,20$	$0,20 < f_0 < 1,05$	$f_0 \geq 1,05$	$f_0 \leq 0,20$	$0,20 < f_0 < 1,05$	$f_0 \geq 1,05$		
Višestambena	40,50	$32,39 + 40,58 \cdot f_0$	75,00	24,84	$19,86 + 24,89 \cdot f_0$	45,99	0	0
Obiteljska kuća	40,50	$32,39 + 40,58 \cdot f_0$	75,00	24,84	$17,16 + 38,42 \cdot f_0$	57,50	0	0
Uredska	16,94	$8,82 + 40,58 \cdot f_0$	51,43	16,19	$11,21 + 24,89 \cdot f_0$	37,34	0	0
Obrazovna	11,98	$3,86 + 40,58 \cdot f_0$	46,48	9,95	$4,97 + 24,91 \cdot f_0$	31,13	0	0
Bolnica	18,72	$10,61 + 40,58 \cdot f_0$	53,21	46,44	$41,46 + 24,89 \cdot f_0$	67,60	0	0
Hotel i restoran	35,48	$27,37 + 40,58 \cdot f_0$	69,98	11,50	$6,52 + 24,89 \cdot f_0$	32,65	0	0
Sportska dvorana	96,39	$88,28 + 40,58 \cdot f_0$	130,89	37,64	$32,66 + 24,91 \cdot f_0$	58,82	0	0
Trgovina	48,91	$40,79 + 40,58 \cdot f_0$	83,40	13,90	$8,92 + 24,91 \cdot f_0$	35,08	0	0
Ostale nestambene	40,50	$32,39 + 40,58 \cdot f_0$	75,00	24,84	$19,86 + 24,89 \cdot f_0$	45,99	0	0

ZEB – Zero Emission Buildings

0?



IZRAČUN EMISIJA CO₂

Osnovni izvor informacija predstavlja EPD proizvoda

EPD = Environmental Product Declaration

Posebno se to odnosi na određivanje /certificiranje LCA kriterija (Life-cycle assessment (analysis) – **procjena životnog ciklusa** zgrade koja uzima u obzir fazu planiranja, izgradnje, korištenja i rušenja zgrade te procjenu troškova životnog ciklusa (**Life cycle cost – LCC**)

Oko 80% KI proizvoda je već pokriveno EPD – ovima.



<https://www.knaufinsulation.com/downloads/environmental-product-declarations-epd>

The screenshot shows a web browser window with the URL <https://www.knaufinsulation.com/downloads/environmental-product-declarations-epd>. The page is titled "ENVIRONMENTAL PRODUCT DECLARATIONS (EPD)". It features a large image of a blue roll of insulation material with a white label that reads "ENVIRONMENTAL PRODUCT DECLARATION (EPD)" and "★★★★★". Below the image, there is a paragraph about Knauf's commitment to environmental impact reduction and reporting. A smaller image of a modern building is shown with the text "HOW OUR PRODUCTS CONTRIBUTE TO GREEN BUILDING RATING SYSTEMS".

AT KNAUF INSULATION, WE ARE COMMITTED TO MEASURING AND REDUCING THE ENVIRONMENTAL IMPACT OF OUR PRODUCTS, AS WELL AS REPORTING THESE IMPACTS IN A TRANSPARENT WAY.

Our EPDs (Environmental Product Declaration) provide customers with objective and independent information about their products. In assessing our sustainability, we examine every stage of a product's life cycle in-depth, from cradle to grave, through LCA (Life Cycle Assessment). This information is then processed and published on our EPDs.

We're pioneers in product sustainability. We have dramatically cut the time needed to create an EPD through an innovative data collection system and third-party pre-verification. Creating an EPD involves highly intensive and wide-ranging data collection, hundreds of calculations, and rigorous verification - which used to take up to 6 months. Our new innovative process has reduced the time it takes to process and publish an EPD to as little as 3 weeks. We are leading the industry in providing such precise information in our EPDs.

HOW OUR PRODUCTS CONTRIBUTE TO GREEN BUILDING RATING SYSTEMS

[Discover more](#)

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KAKO IZRAČUNATI UTJECAJ?



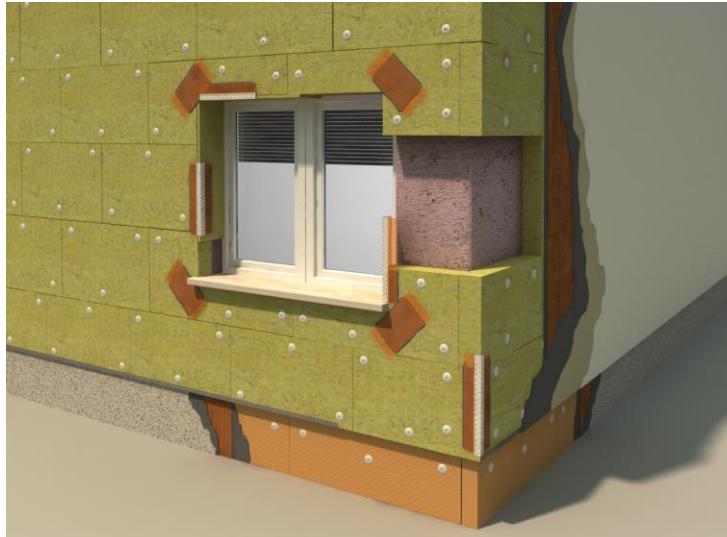
ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1 for:

**FKD N Thermal, SmartWall N C1, SmartWall N C2,
MW Dammplatte 034 Evo, MW Dammplatte 034
Evo+**

From

knaufinsulation



Program:	The International EPD® System
Programme operator:	www.environdec.com
EPD registration number:	EPD International AB
Publication date:	S-P-01882
Validity date:	2020-07-06
	2025-07-06

EPD®

EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammplatte 034 Evo, MW Dammplatte 034 Evo+



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KAKO TO IZRAČUNATI?



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General information

Information about the company

Description of the organisation:
Knauf Insulation has more than 40 years of experience in the insulation industry and is one of the most respected names in insulation worldwide. Knauf Insulation is manufacturing products and solutions mainly in glass and rock mineral wool, as well as wood wool. We operate more than 37 manufacturing sites globally in 15 countries and employ more than 5,000 people. The Headquarters are located in Visé, in Belgium.

Product-related or management system-related certifications:

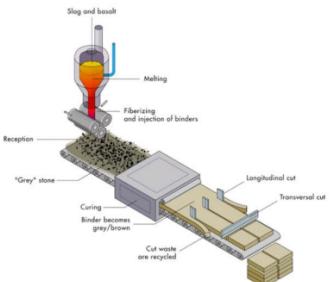
All Knauf Insulation sites, including the related site for this EPD, are ISO 9001, ISO 14001, ISO 5001 and ISO 45001 certified under the scope "Design, Development and Production of Insulation Materials and Systems".

Information about Rock Mineral Wool production

The Rock Mineral Wool Products for Building Construction are available in the form of slabs, boards, lamellas and rolls. RMW slabs are used as a thermal, acoustical and fire insulation product. Knauf Insulation adopts a "worst case" approach into its EPDs.

In general, the density for rock mineral wool products ranges from 20 to 200 kg/m³. In terms of composition, the inorganic part (92-98%) is composed of volcanic rocks, typically basalt, and some dolomite and with an increasing proportion of recycled material in the form of briquettes, a mix of stone wool scrap, other secondary materials and cement.

The remaining fraction is the thermo set resin binder.



3

EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+

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Product information

Product(s) name: SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+

Product identification: The declared insulation product is/are SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+, a rock mineral wool, uncoated, one side coated and both sides coated surface, unfaced slab of 1 square meter (considered for this EPD). It needs a Declaration of Performance taken into consideration the harmonized product standard EN 13162 and the CE mark.

For the placing on the construction products market in the European Union/ EFTA (with exception of Switzerland), the Regulation/ (EU) No 305/2011 applies. The concerned products need Declarations of Performance /DoP R4308MPCP/ taking into consideration the harmonized product standard /EN 13162/ and the CE-mark.

Product description: The main application for SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+ is ETICS (External Thermal Insulation Composite Systems).

LCA information

Functional unit / declared unit:

The declared unit is 1 square meter of unfaced, both sides coated Rock Mineral Wool SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+ with a thickness of 100mm. The declared lambda is 0.034 W/mK. The density used for the calculation of this specific LCA is 90kg/m³.

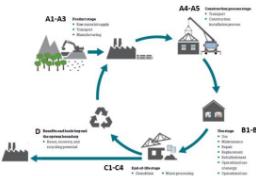
Reference service life: The RSL or durability of SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+ is as long as the lifetime of the building equipment in which it is used (at least 50 years).

4

EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+

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System diagram:



Description of system boundaries:

The system boundary of the EPD follows the modularity approach defined by the /EN 15804+A1.

The type of EPD is cradle-to-grave.

List and explanation of the modules declared in the EPD.

The product stage (A1-A3) includes:

- A1 - raw material extraction and processing, processing of secondary material input (e.g. recycling processes),
- A2 - transport to the manufacturer and
- A3 - manufacturing,

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 during the product stage.

The LCA results are given in an aggregated form for the product stage, meaning that the modules A1, A2 and A3 are considered as a unique module A1-A3.

Product Parameters	Value
Declared Density	90 kg/m ³
Rock mineral wool weight (without coating)	9.0 kg
Surface	1 m ²
Thickness	100 mm
Volume	0.1 m ³
Coating	0.4 kg
Packaging Plastic sheet	0.1 kg
Packaging Wooden pallet	1.04 kg

The end-of-life stage includes:

- C1 - de-construction, demolition,
- C2 - transport to waste processing,
- C3 - waste processing for reuse, recovery and/or recycling and
- C4 - disposal.

This includes provision for the disposal of materials, products and related energy and water use. The common manual dismantling impact of insulation is considered as very small and can be neglected in C1.

5

EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+

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Although Rock Mineral Wool products from Knauf Insulation can be recycled at their end-of-life, an established collection system does not yet exist in every country.

Therefore, the assumption chosen in this study, 100% landfill (C4) after the use phase, is the most conservative approach.

Parameter	Value
Average transport distance	600 km
Type of fuel and vehicle consumption or type of vehicle used for transport	Truck, Euro 6 (28 – 32 t / 22 t payload); 33 L for 100 km.
Truck capacity utilization (including 30% of empty returns)	34% of the weight capacity
Loss of materials in construction site	2%
Packaging Wooden pallet	100% incinerated
Packaging Plastic sheet	40% recycled, 60% incinerated
Truck capacity utilization	70 % of the weight capacity

through the use of briquettes (mineral wool waste and additional cement) that are reinjected into the batch. The external recycled waste as raw material is 28% originating (mainly) from slags.

Additional information:

All raw materials for the manufacturing of the declared product, the required energy, water consumption and the resulting emissions are considered into the LCA. Consequently, the recipe components with a share even less than 1% are included. All neglected processes contribute less than 5% to the total mass or less than 5% to the total energy consumption. For information, the impact of the Rock Mineral Wool plant construction or machines, are not taken into account in the life cycle assessment. No allocation is carried out for this specific product.

More information:
www.knaufinsulation.com
<http://www.knaufinsulation.sk/en>
<https://www.knaufinsulation.it/>

Name and contact information of LCA practitioner:

Yaprak Nayir
Knauf Insulation Sprl
Rue de Maestricht 95
4600 Visé
Belgium
Contact: yaprak.nayir@knaufinsulation.com

knaufinsulation

6

EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dampplatte 034 Evo, MW Dampplatte 034 Evo+

23. ‘whole life-cycle greenhouse gas emissions’ means the combined greenhouse gas emissions associated with the building at all stages of its life-cycle, *considering the benefits from reuse and recycling at the end-of-life*, from the ‘cradle’ (the extraction of the raw materials that are used in the construction of the building) over the material production and processing, and the building’s operation stage, to the ‘*end of life*’ (the deconstruction of the building and reuse, recycling, other recovery and disposal of its materials);
24. ‘Life-cycle Global Warming Potential (GWP)’ means an indicator which quantifies the global warming potential contributions of a building along its full life-cycle;



KAKO TO IZRAČUNATI?



Product stage		Construction process stage		Use stage						End of life stage				Resource recovery stage		
Raw materials	Transport	Manufacturing	Transport	Construction/Installation		Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction/demolition	Transport	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Environmental performance

Potential environmental impacts: 1 m² of Rock Mineral Wool SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammplatte 034 Evo, MW Dammplatte 034 Evo+ with a thickness of 100 mm.

PARAMETERS	UNIT	TOTAL A1-A3	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Global warming potential (GWP)	kg CO ₂ eq.	9.26	0.672	2.42	0	0	0.0325	0	0.128	-0.853
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	1.49E-11	1.09E-16	1.76E-10	0	0	5.39E-18	0	7.06E-16	-3.22E-14
Acidification potential (AP)	kg SO ₂ eq.	0.0946	0.00126	0.00211	0	0	0.000139	0	0.000823	-0.00103
Eutrophication potential (EP)	kg PO ₄ 3- eq.	0.00269	0.000303	9.81E-05	0	0	3.44E-05	0	9.27E-05	-0.000131
Formation potential of tropospheric ozone (POCP)	kg C ₂ H ₄ eq.	0.00486	0.000141	0.000116	0	0	1.26E-05	0	6.19E-05	-9.86E-05
Abiotic depletion potential – Elements	kg Sb eq.	7.93E-06	5.53E-08	1.81E-07	0	0	2.73E-09	0	4.95E-08	-1.57E-07
Abiotic depletion potential – Fossil resources	MJ, net calorific value	146	9.06	3.29	0	0	0.447	0	1.82	-13

Ukupna vrijednost utjelovljenog CO₂ za 1 m² =
 $9,26 + 0,672 + 2,42 + 0,0325 + 0,128 = 12,51 \text{ kg CO}_2$ za
toplinski otpor R = 2,94 m²K/W

KAKO TO IZRAČUNATI?



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Use of resources: 1 m² of Rock Mineral Wool SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammpalte 034 Evo, MW Dammpalte 034 Evo+ with a thickness of 100mm.

PARAMETER	UNIT	TOTAL A1-A3	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*	
Primary energy resources - Renewable	Used as energy carrier	MJ net calorific value	12.375	0.51	0.368	0	0	0.0252	0	0.245	-2.88
	Used as raw materials	MJ net calorific value	15.625	0	0.000	0	0	0	0	0	0
	TOTAL		28	0.51	0.368	0	0	0.0252	0	0.245	-2.88
Primary energy resources - Non-renewable	Used as energy carrier	MJ net calorific value	143.046	9.09	3.418	0	0	0.448	0	1.88	-15.4
	Used as raw materials	MJ net calorific value	10.954	0	0.132	0	0	0	0	0	0
	TOTAL		154	9.09	3.55	0	0	0.448	0	1.88	-15.4
Secondary material	kg		2.55	0	0.051	0	0	0	0	0	0
Renewable secondary fuels	MJ net calorific value		4.33E-19	0	8.66E-21	0	0	0	0	0	-6.20E-25
Non-renewable secondary fuels	MJ net calorific value		5.08E-18	0	1.02E-19	0	0	0	0	0	-7.29E-24
Net use of fresh water	m ³		0.039	0.000591	0.000607	0	0	2.91E-05	0	0.000473	-0.00341

*: [Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].

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EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammpalte 034 Evo, MW Dammpalte 034 Evo+

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Waste production and output flows: 1 m² of Rock Mineral Wool SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammpalte 034 Evo, MW Dammpalte 034 Evo+ with a thickness of 100mm.

Waste production

PARAMETER	UNIT	TOTAL A1-A3	A4	A5	TOTAL B1-B7	C1	C2	C3	C4	D*
Hazardous waste disposed	kg	3.44E-07	4.23E-07	6.31E-09	0	0	2.09E-08	0	2.86E-08	-6.01E-09
Non-hazardous waste disposed	kg	0.82	0.00139	0.221	0	0	6.86E-05	0	9.43	-0.00637
Radioactive waste disposed	kg	0.00329	1.12E-05	0.000104	0	0	5.55E-07	0	2.13E-05	-0.000972

Output flows

PARAMETER	UNIT	TOTAL A1-A3	A4	A5	TOTAL B1-B7	C1	C2	C3	C4	D*
Components for reuse	kg	0	0	0	0	0	0	0	0	0
Material for recycling	kg	0	0	0.0422	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0	0
Exported energy, electricity	MJ	0	0	0.334	0	0	0	0	0	2.85
Exported energy, thermal	MJ	0	0	1.1	0	0	0	0	0	5.12

*: [Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].

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EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammpalte 034 Evo, MW Dammpalte 034 Evo+

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LCA interpretation

ENVIRONMENTAL IMPACTS

All impact categories, except the Abiotic Depletion Potential Element and the Ozone Depletion Potential, are dominated by the production processes. This can be explained by the huge impact of the energy use (electricity, natural gas and coke) for Rock Mineral Wool production.

The Global Warming Potential (GWP) is dominated by the production in the cupola, mostly due to CO₂ emissions from raw materials and energy consumption (50%). The production of the binder represents more than 15% of the impact.

The Ozone layer Depletion Potential (ODP) results are under the high influence of the selected scenario for plastic sheets packaging incineration.

The Acidification Potential (AP) is also dominated by the production due to the emissions related to the processes and the energy consumption.

The Eutrophication Potential (EP) is significantly influenced by the production due to emissions from cupola furnace, curing oven and other unit processes.

The Photochemical Ozone Creation Potential (POCP) is particularly dominated by the production (emissions in the cupola furnace and other unit processes).

The Abiotic Depletion Potential Element (ADPe) is mainly due to the cement utilized in the briquettes production process in order to recycle secondary materials from the lines, the briquettes are reinjected into the melting batch. The impact of the raw materials in general, like the volcanic rock basalt, is very minor as this material is very abundant on Earth. The thermo set resin binder has also an important impact on ADPe indicator due to the fossil origin.

The Abiotic Depletion Potential Fossil (ADPF) is dominated by the use of coke as energy carrier. Next to the coke, we have also the impact of natural gas and upstream the electricity energy mix.

RESOURCES USE

Total Use of Non-Renewable Primary Energy Resources (PENRT) is dominated by the production of rock mineral wool products (especially due to the energy carrier, coke) and the binder.

Total Use of Renewable Primary Energy Resources (PERT) is dominated by the production, mostly due to electricity consumption and packaging.

For the Use of Secondary Material (SM), it consists of slags and some minor mineral wool external waste are also considered.

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EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammpalte 034 Evo, MW Dammpalte 034 Evo+

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Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture



KI EcolIndex calculator (Tool)

Af



Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

KI EcolIndex calculator - cilj



Stvoriti „eko alat” koji će omogućiti prezentaciju i analizu utjecaja proizvoda na okoliš putem jednog pokazatelja.

KI EcolIndex Tool – značajke

- Mogućnost lagane prijave za korisnike
- Dodavanje proizvoda u alat kopiranjem podataka iz EPD-a
- Učinkovit prijenos tablica
- Spremanje unesenih podataka radi ponovnog korištenja
- Mogućnost uspoređivanja proizvoda i sustava kroz usporednu cijenu („shadow price“)
- Usporedba izolacijskih proizvoda **iste R vrijednosti**
- Konfiguiriranje i uspoređivanje sustava
- Uspoređivanje proizvoda u smislu utjelovljenog ugljika
- Dinamičko stvaranje, uređivanje i spremanje grafikona u smislu faza životnog ciklusa ili kategorija utjecaja
- Grafovi („stupići“) paralelnih usporedbi proizvoda
- Grafovi („tortice“) za analizu i raščlambu jednog proizvoda

- Alat promatra 6 utjecajnih kategorija: potencijal/ negativan utjecaj na globalno zagrijavanje, osiromašenje (oštećenje) ozona, acidifikaciju („zakiseljavanje”), eutrofikacija (negativan utjecaj na vode (unošenje prekomjernih kolčina dušika, fosfora,...), stvaranje fotokemijskog ozona (smoga) i abiotički utjecaj na ne-fosilne resurse
- Izračun u skladu s EN 15804 +A1 & +A2 na temelju cijena negativnog utjecaja na okoliš na razini 2019. godine.
- Cijene životnog okoliša izračunate su za trošak zagađenja ili štete odnosno ukazuju na gubitak gospodarskog razvoja do kojeg dolazi radi onečišćenja od strane tvari u okolišu. Tu naravno dolazi do dosta ograničenja , ali ipak omogućuje holistički pristup iako ta cijena **nikad neće zamijeniti pokazatelje i stvaran, štetan utjecaj na okoliš**.



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Start Analysis Carbon Calculator Browse Comparison Browse EPDs Logout

Start Analysis

Product System

R Value 4 ✓

Added product
Naturboard 037, Ultracoustic P, TP 115, TP 116, Space Slab 037, AKUSTIK BOARD and Acoustifit

Added product
NaturBoard VENTI GVB, NaturBoard VENTI

Added product
FKD N Thermal, SmartWall N C1, SmartWall N C2, MW Dammplatte 034 Evo, MW Dammplatte 034 Evo+

Added product
PI thermal insulation boards made of block

Chart 1

Total Product Shadow Price

Product	Global warming potential	Depletion potential of the ozone layer	Acidification of land and water	Eutrophication potential	Formation potential of tropospheric ozone photometrical oxidants	Abiotic depletion potential for non-fossil resources
Naturboard 037, Ultracoustic ...	0.35	0.00	0.00	0.00	0.00	0.00
NaturBoard VENTI GVB, Natu...	1.21	0.14	0.00	0.00	0.00	0.00
FKD N Thermal, SmartWall N...	1.97	0.31	0.00	0.00	0.00	0.00
PU thermal insulation boards ...	2.47	0.00	0.00	0.00	0.00	0.00

Add Chart



ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1 for:

Naturboard 037, Ultracoustic P, TP 115, TP 116, Space Slab 037, AKUSTIK BOARD and Acoustifit

Mineral Wool Slabs 037 Group

From

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Program:	The International EPD® System
Programme operator:	www.environdec.com
EPD registration number:	EPD International AB
Publication date:	S-P-03122
Validity date:	2021-04-06
Version number	2026-04-06
Date of Update	3
	2022-02-25

EPD®



ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1 for:

NaturBoard VENTI GVB, NaturBoard VENTI

From

knaufinsulation



Program:	The International EPD® System
Programme operator:	www.environdec.com
EPD registration number:	EPD International AB
Publication date:	S-P-01847
Validity date:	2020-04-29
Revision date:	2025-04-29
	2020-12-08

EPD®

EPD NaturBoard VENTI GVB, NaturBoard VENTI



ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1 for:

FKD N Thermal, SmartWall N C1, SmartWall N C2, MW Dammplatte 034 Evo, MW Dammplatte 034 Evo+

From

knaufinsulation



Program:	The International EPD® System
Programme operator:	www.environdec.com
EPD registration number:	EPD International AB
Publication date:	S-P-01882
Validity date:	2020-07-06
	2025-07-06

EPD®

EPD SmartWall N C1, SmartWall N C2, FKD N Thermal, MW Dammplatte 034 Evo, MW Dammplatte 034 Evo+



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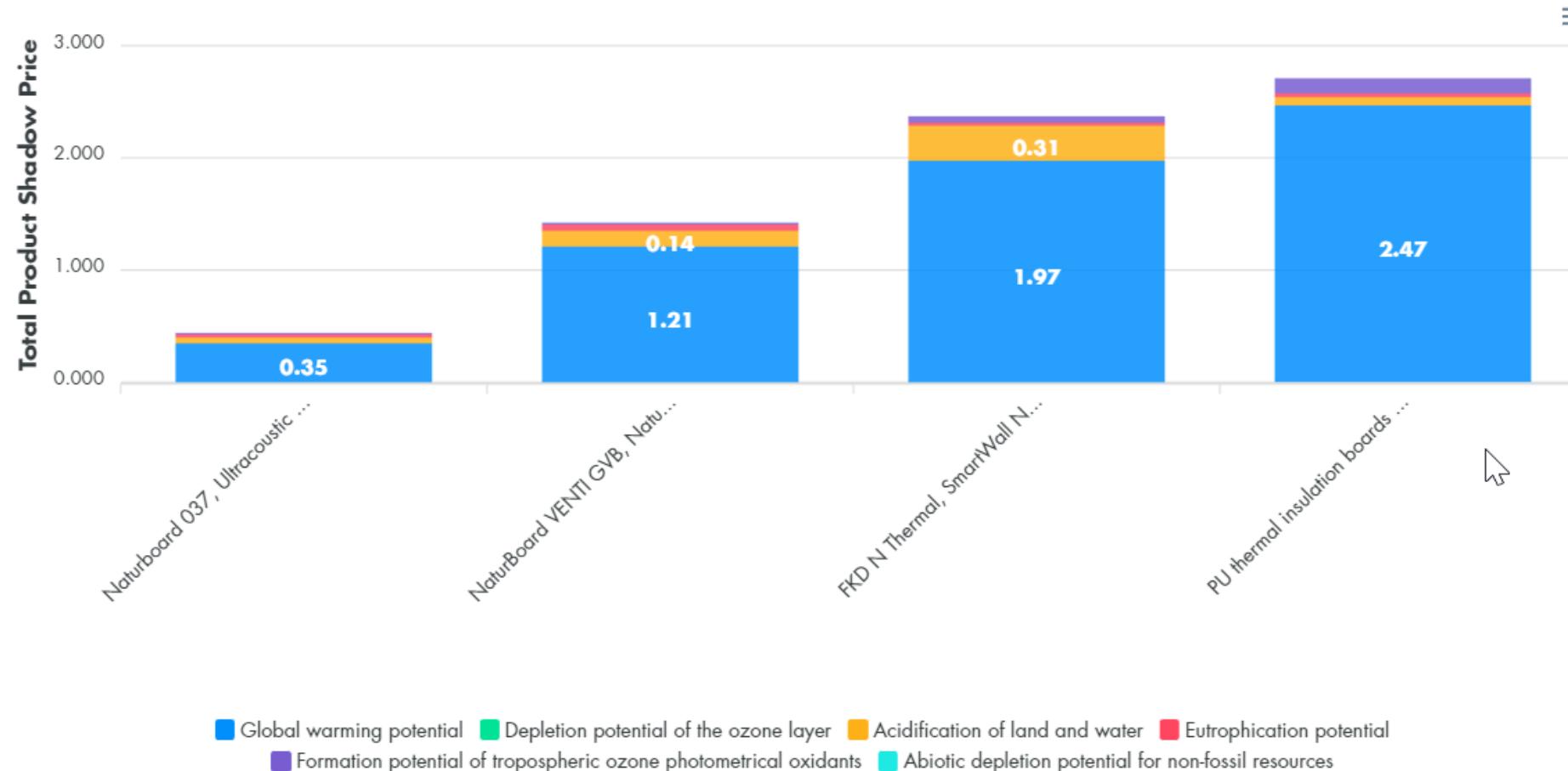


Utjecaj na okoliš/usporedba kroz usporednu cijenu (shadow price) kroz cijeli životni ciklus



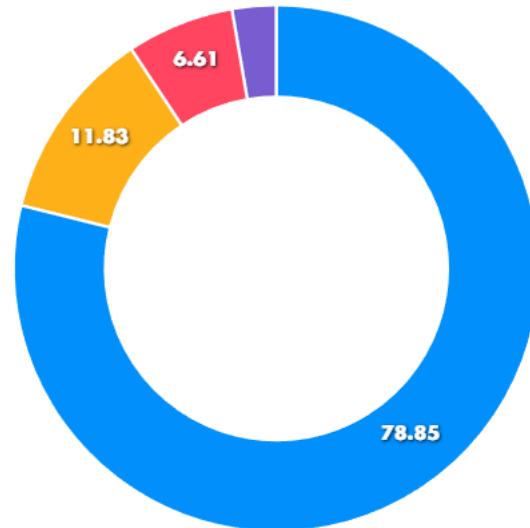
Product name	Manufacturer	λ	EPD expiration date	Total product shadow price	
▼ Naturboard 037, Ultracoustic P, TP 115, TP 116, Space Slab 037, AKUSTIK BOARD and Acoustifit	Knauf Insulation	0.037	06/04/2026	0.44 €	✖
▼ NaturBoard VENTI GVB, NaturBoard VENTI	Knauf Insulation	0.035	29/04/2025	1.42 €	✖
▼ FKD N Thermal, SmartWall N C1, SmartWall N C2, MW Dammplatte 034 Evo, MW Dammplatte 034 Evo+	Knauf Insulation	0.034	06/07/2025	2.37 €	✖
▼ PU thermal insulation boards made of block foam	IVPU e.V.	0.026	01/09/2022	2.71 €	✖

Utjecaj na okoliš/usporedba kroz cijenu (shadow price) kroz cijeli životni ciklus – za $R = 4 \text{ m}^2\text{K/W}$



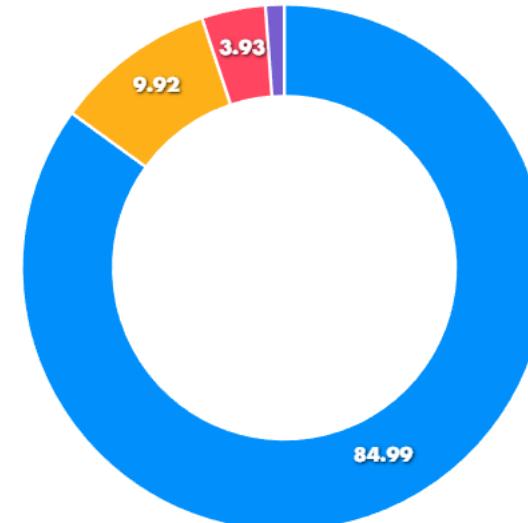
■ Global warming potential ■ Depletion potential of the ozone layer ■ Acidification of land and water ■ Eutrophication potential
■ Formation potential of tropospheric ozone photometrical oxidants ■ Abiotic depletion potential for non-fossil resources

Naturboard 037



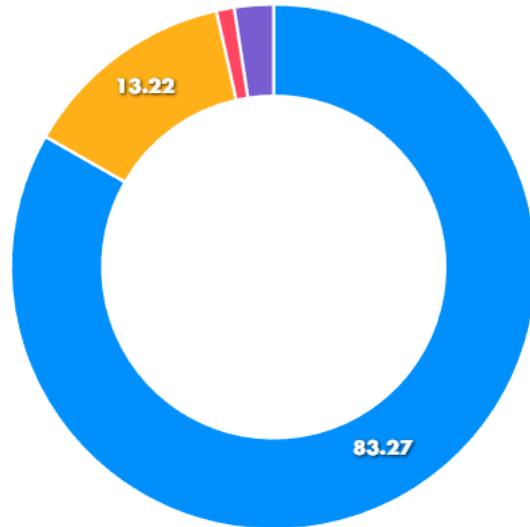
- Global warming potential
- Depletion potential of the ozone layer
- Acidification of land and water
- Eutrophication potential
- Formation potential of tropospheric ozone photometrical oxidants
- Abiotic depletion potential for non-fossil resources

NaturBoard VENTI GVB, NaturBoard
VENTI



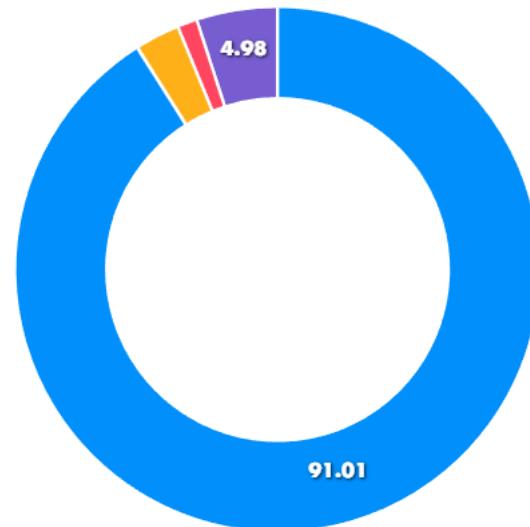
- Global warming potential
- Depletion potential of the ozone layer
- Acidification of land and water
- Eutrophication potential
- Formation potential of tropospheric ozone photometrical oxidants
- Abiotic depletion potential for non-fossil resources

FKD N Thermal



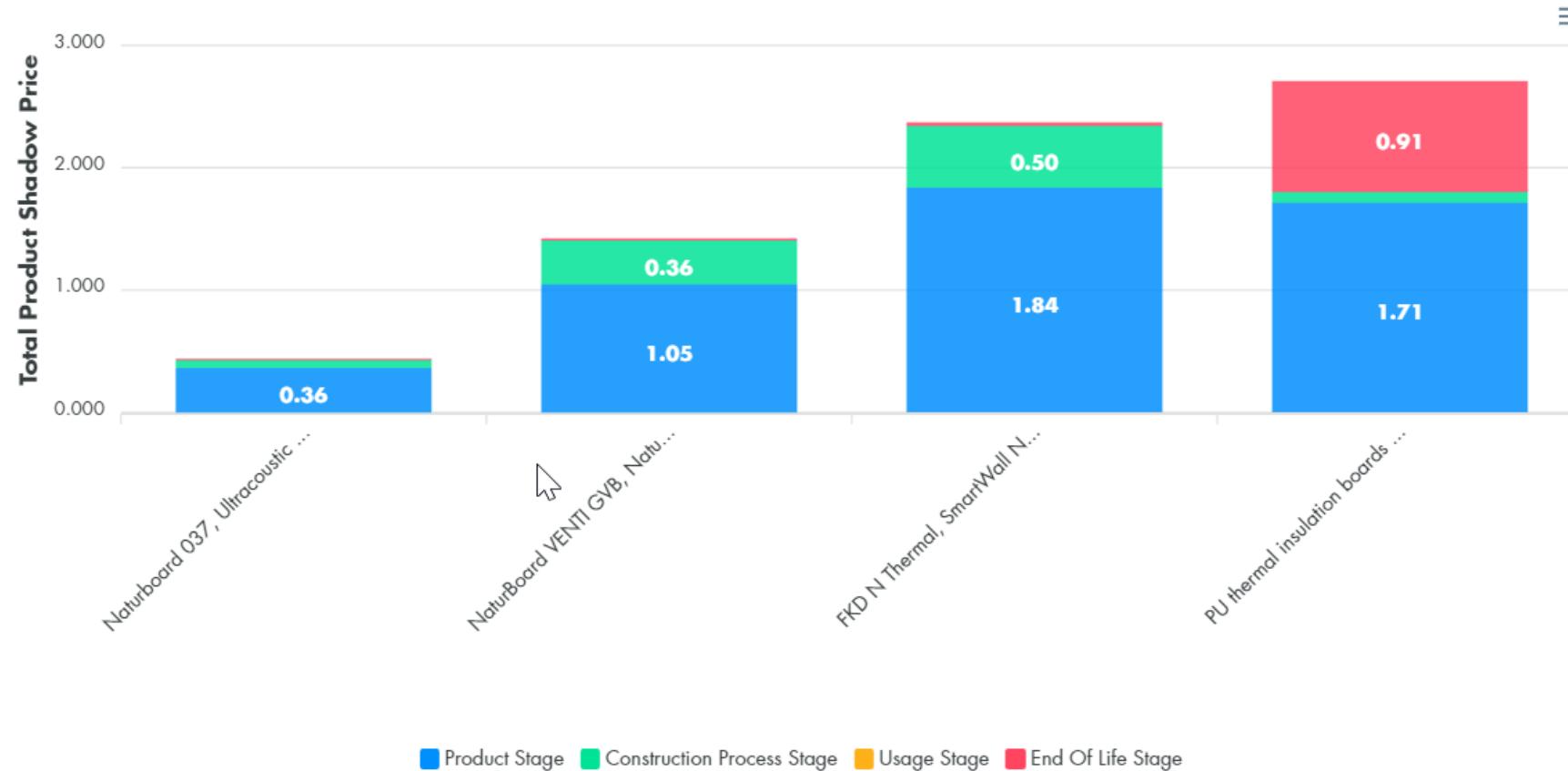
- Global warming potential
- Depletion potential of the ozone layer
- Acidification of land and water
- Eutrophication potential
- Formation potential of tropospheric ozone photometrical oxidants
- Abiotic depletion potential for non-fossil resources

PU thermal insulation boards made of block foam



- Global warming potential
- Depletion potential of the ozone layer
- Acidification of land and water
- Eutrophication potential
- Formation potential of tropospheric ozone photometrical oxidants
- Abiotic depletion potential for non-fossil resources

Usporedba utjecaja na okoliš kroz usporednu cijenu po svakoj fazi životnog ciklusa za R = 4 m²K/W



■ Product Stage ■ Construction Process Stage ■ Usage Stage ■ End Of Life Stage

Mineralne vune i proizvodnja istih ima ogroman potencijal ušteda energije i emisije štetnih plinova, prvenstveno po pitanju smanjenja emisije CO₂, ali i ostalih negativnih utjecaja na okoliš kroz promjene, prvenstveno u fazi proizvodnje (promjena energenta, način pakiranja i obilježavanja (smanjenje pokrivenosti bojom na max 15% površine (70% smanjenje) što će rezultirati toliko i povećanjem količine materijala koji se može reciklirati, transport itd.) što je u svakom slučaju daleko bolje u odnosu na zbrinjavanje kod kojeg nažalost ne postoji previše alternativa i što će se vremenom postajati sve veći problem..



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Silvio Novak, dipl.ing.građ.
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Knauf Insulation d.o.o. Novi Marof

Žan Aleksander Božić
PMO System Division
Knauf Insulation d.o.o. Škofja Loka



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