Deliverable D 4.8

Sustainability assessment of ESH

WP 4

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Participant no. and legal name		Acronym	Country
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3	**GRADBENI INSTITUT ZRMK DOO**	**GI ZRMK**	**Slovenia**
4	ROBOTINA D.O.O., PODJETJE ZA INZENIRING, MARKETING, TRGOVINO IN PROIZVODNJO	ROBOTINA	Slovenia
5	CYBROTECH LIMITED	CYBROTECH	United Kingdom
6	ELEKTRON	ELEKTRON	Croatia
7	UNIVERSITY OF LJUBLJANA, FACULTY OF SOCIAL SCIENCES	UL	Slovenia
8	CCS	CCS	Slovenia
9	RED	RED	Italy
10	UMEA	UMEA	Sweden

Abbreviations

BC	Business Case
CA	Consortium Agreement
i.e.	id est (engl. = that is to say)
IPR	Intellectual Property Rights
RTD	Research and Technological Development
S & T	Scientific and Technological
SME	Small and Medium-sized Enterprise
WP	Work package
ESH	Eco Silver House
HVAC	heating, ventilation, and air conditioning
ICC	Intelligent control centre
w.r.t.	With respect to

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1. TASK DESCRIPTION

Task 4.6: Sustainability assessment of ESH (LCA, LCC, social aspect) (Task leader: GI ZRMK, partners involved: ROBOTINA, UL, CCS)

Building project can be regarded as sustainable only when all the various dimensions of sustainability (environmental, economic, social, and cultural) are dealt with. The various sustainability issues are interwoven, and the interaction of a building with its surroundings is also important. The environmental issues share, in common, concerns which involve the reduction of the use of non-renewable materials and water, and the reduction of emissions, wastes, and pollutants.

The sustainability assessment will be done by GI ZRMK, other partners will provide the necessary data from their respective fields.

2. OBJECTIVES

A variety of sustainability assessment tools are currently available and the task of this task is to identify which of the methodology available is most suitable for the ESH building and to implement it. Several methods may be used; but the task leader will develop this Task based on the experiences and findings of the ongoing project FP7 OPEN HOUSE (2010-2012), where the scope is to develop a method for sustainability assessment for daily construction practice. The detailed transfer of information is possible since two consortium members SCC and GI ZRMK are also partners in FP7 OPEN HOUSE. Thus the concept of building sustainability assessment according to CEN/TC/350 will be followed.

3. EXECUTIVE SUMMARY

Sustainability assessment of ESH building was performed according to FP7 OPEN HOUSE methodology. The selection of the method is a result of comparison of various commercial methodologies (DGNB, LEED, BREEAM) and free methods (OPEN HOUSE, CESBA, BNB). Open source, flexibility, weighting adjustment possibility were the most important elements for decision. OPEN HOUSE is an open source internationally oriented method for assessment of sustainable building (SB). Methodology offers different levels of assessment: i.e. quick (and) basic or complete assessment that is based on the OPEN HOUSE core or full system inf indicators, respectively. Full system includes all indicators, core system includes only core indicators.

Sustainability assessment takes into account six categories of building construction. Environmental quality, social/functional quality, economic quality, technical characteristics, process quality and site location.

Overall and final rating of the building is the average of rates in three main categories, environmental quality, social/functional quality and economic quality. These three categories are all weighted equally, where each category represents 1/3 of final result (points). Other three categories: social/functional, process and site quality are not integrated into the score, although the assessment was done for all core indicators and some other cross-related indicators. It has to be specified, that economic quality category include results of individual indicators from technical characteristic and process quality category.

Results of technical characteristics, process quality and location category can be assessed independently and do not effect the final result of overall building performance, except for those individual indicators, that are included in economic quality category and therefore indirectly influence the result of economic quality category.

For the purpose of sustainable assessment of Eco Silver House (ESH) building all indicators from main three categories have been assessed and all core indicators from three additional categories, technical characteristics, process quality and location. In addition, assessment was performed for all additional indicators from technical characteristics and process quality category, that indirectly influence economic quality category. Weighting factors (range 0-4) for each indicator are set for local level (Slovenia), as a part of the methodology. Weights for different indicator were developed within FP7 OPEN HOUSE (2010-2012) project.

LCA assessment was performed using eco2soft online calculator from IBO GmbH that provided the results for six core indicators for sustainability assessment. Energy demand of ESH was calculated according to PHPP methodology. Simulations of indoor environment were calculated using dynamic simulation with IDA ICE software.

Further information about assessment of indicators are available below in the document. For each indicator assessed, the evaluation table/scale with OPEN HOUSE criteria and points awarded to ESH are shown.

4. DESCRIPTION OF SUSTAINABILITY ASSESSMENT METODOLOGY

Sustainability assessment was done according to OPEN HOUSE methodology[1,2] developed within the FP7 OPEN HOUSE (2010-2012) project.

The evaluation methodology according to FP7 OPEN HOUSE (2010-2012) is defined with hierarchical structure of assessed indicators. Evaluation includes 6 main categories that describe the building as a whole:

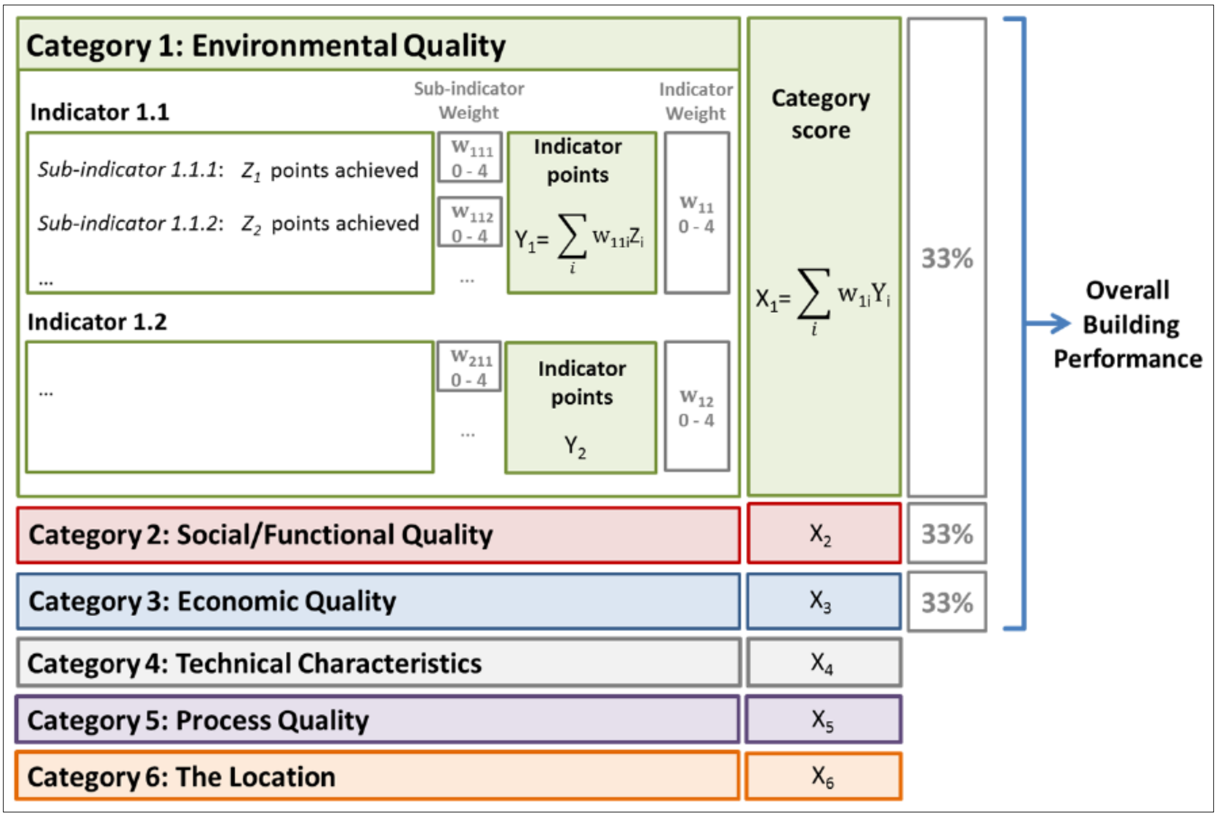
- **Environmental Quality**
- **Economic Quality**
- **Social/Functional Quality**
- Technical Characteristics
- Process Quality
- The Location

Picture 1: Overview of the 6 assessment categories of the OPEN HOUSE framework (source: OPEN HOUSE Assessment Guideline)

Each of the above category is composed of several indicators assessing different key issues for the sustainability performance of the project. Each indicator consists in one or several sub-indicators that evaluate a precise issue covered by the indicator topic.

Fulfilling requirements set by sub-indicators awards a certain amount of points ranging from 0 to 100 depending on the performance met. Each sub-indicator is weighted from 0 to 4, with 0 meaning the sub-indicator is irrelevant, and 4 it is of high importance. The score for each indicator is the weighted average of the points awarded for the sub-indicators. Each indicator is weighted from 0 to 4, and the score achieved for each category is the weighted average of the points awarded for the indicators.

[1] http://www.openhouse-fp7.eu/assets/files/D1.5_APPENDIX_D.pdf
[2] http://www.openhouse-fp7.eu/assets/files/OPEN_HOUSE_AG1.2.pdf



Picture 2: Overview of the scoring process (source: OPEN HOUSE Assessment Guideline)

The final building performance is obtained by calculating the average of the environmental, social and economic category scores. (Environmental, social and economic categories are equally weighted), the three other categories are evaluated separately. Evaluation of building is presented with scoring card. The scoring card is the table containing all information about the score achieved for each sub-indicator, indicator, category and overall building performance. It also displays the different weightings for each sub-indicator, indicator and category.

The OPEN HOUSE methodology is available in two different assessment schemes: The basic and quick sustainable assessment will give a first idea of the sustainability level of the building and will propose actions to improve the level. Basic assessment is usually applied best in earlier planning phases and is based mainly on estimations as well as design targets. It is based on the OPEN HOUSE full system with all available indicators. The complete assessment can be done, when the building is finished. It is based on calculations and precise documentation.

5. DESCRIPTION OF LIFE-CYCLE ASSESSEMENT FOR ECO SILVER HOUSE - ESH

LCA indicators for ESH were calculated with eco2soft[3] online calculator. Eco2soft calculation provided the results for six core (LCA) environmental indicators needed for sustainability assessment according to OPEN HOUSE methodology. LCA environmental quality indicators calculated with eco2sot are:

- **Global Warming Potential (GWP)**
- **Ozone Depletion Potential (ODP)**
- **Acidification Potential (AP)**
- **Eutrophication Potential (EP)**
- **Photochemical Ozone Creation Potential (POCP)**
- **Abiotic depletion of non-renewable fossil fuels due to non-renewable Primary Energy Demand (ADP_Enr)**

Eco2soft tool is used for ecological assessment of individual building structures and buildings. Software enables the calculation of environmental impact of buildings over the entire life cycle with consideration of construction materials used, operating life of individual components and disposal of material after demolition. The tool also offers access to the IBO material library with product-specific or product reference values for different building materials.

The purpose of the LCA analysis was to evaluate this six core indicators of ESH building. 50 years assessment period was chosen for the evaluation, in line with the OPEN HOUSE methodology.

Life cycle assessment of Eco Silver House (ESH) is based on actual characteristics of completed building. For evaluation of individual indicators, additional variation of ESH building was developed, that would serve as a reference scenario. Reference scenario is a variation of ESH building that meets only basic and legally required energy efficiency parameters that are currently demanded by Slovenian national construction code. This scenario differs from the actual implementation in that it does not have mechanical ventilation with heat recovery system, windows have double glazing, and the outer walls have less thermal insulation then actual implementation (only to meet the legal requirements of the thermal transmittance – maximum U-value). Reference scenario defines benchmarks for evaluation of actual completed ESH building

Points awarded for particular indicator are based on project documentation, different energy simulations, simulations of thermal environment and measurements performed on actual building site.

To evaluate environmental indicators, two building models were developed. First model based on actual characteristics of completed building, second model performing as reference building scenario. Reference building model had to be developed within this task in order to evaluate

[3] http://www.ibo.at/de/ecosoft.htm

environmental impact of ESH. It has to be specified, that Slovenia currently doesn't have a legal reference building model that could be used for this type of evaluation.

Basic boundary conditions and the scope of actual ESH building assessment with eco2soft building calculator includes the following life cycle stages:

- **Production stage:** all the processes upstream of the point when the product is ready for shipment are taken into account (raw material supply, transport to manufacturing, manufacturing).
- **Use stage:** standard service life data for building construction components are taken in account. Delivered energy for heating, domestic hot water preparation, and auxiliary electricity for building systems is included in evaluation. Energy demand of ESH is calculated according to PHPP methodology.
- **End-of-life stage:** waste processing and disposal of the building is included in calculation, standard data for material disposal is used within this evaluation.
- **Reference study:** LCA period of 50 years is used according to OPEN HOUSE methodology.
- Product-specific values for building materials were used if available from IBO material library.
- Product-reference values for building materials were used when building materials not available in IBO material library

Reference scenario takes into account the same life cycle stages, material properties and boundary conditions with the difference in higher energy consumption for heating and domestic hot water preparation and less thermal insulation material in building envelope. Reference scenario also has lower electricity demand for building systems, because the mechanical ventilation with heat recovery is not included in reference model. Reference building, as described before, meets only the minimum national requirements for new construction according to legislation PURES 2010. Differences between both building models are presented in table1.

Eco2soft tool uses flexible envelope boundary concept, where different structural and technical components can be included in calculation. **Results of eco2sof calculation for boundary BG5, presents the basis for further sustainable evaluation according to OPEN HOUSE METODOLOGY**.

Level of ….	Scope of analysis
BG0	structures of the thermal building envelope incl. Intermediate floors excl. damp proofing (in the floor slab and in the roof outside the insulation layer) excl. rear-ventilated façade elements excl. roof cladding
BG1	Basing on BG0, all structures of the thermal building envelope complete (incl. Intermediate floors)
BG2	Basing on BG1, incl. inside walls (dividing elements)
BG3	Basing on BG2, incl. inside walls (all inside walls) incl. complete basement incl. non-heated buffer spaces (complete building) excl. direct access
BG4	Basing on BG3, incl. direct access (stairways, covered walkways etc.)
BG5	Basing on BG4, incl. housing technology
BG6	Basing on BG5, incl. all accesses incl. adjoining buildings

Picture 3: Flexible boundary concept; (Source: IBO GmbH - IBO-Guidelines to calculating the OI3 indicators for buildings)

From BG2, boundary useful life of building components may already be included in calculation, but from boundary BG3 onwards, useful life of the structural element layers is mandatory. Envelope boundary BG5 covers a building in its entirety. Envelope boundary. BG6 refers to building complexes.

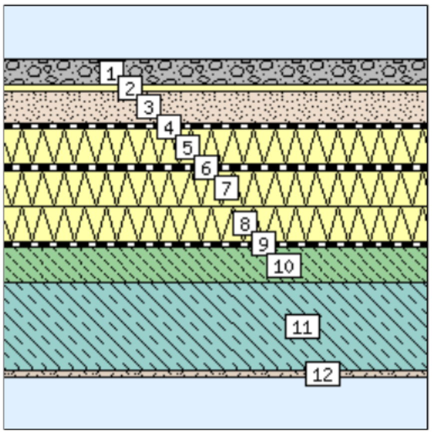
5.1 RESULTS OF LCA FOR ESH building

5.1.1 Results for solid and transparent building elements - ESH

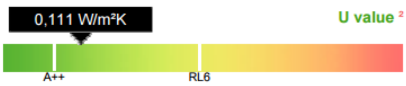
Results and graphic details of solid and transparent building elements calculated with eco2soft for ESH building are presented below. All structures of thermal building envelope, all intermediate floors and partition walls have been included in building model.

e3 - Green roof

Ceiling, roof: Flat or pitched roof exposed to outside air – not back-ventilated – heat flow ascending



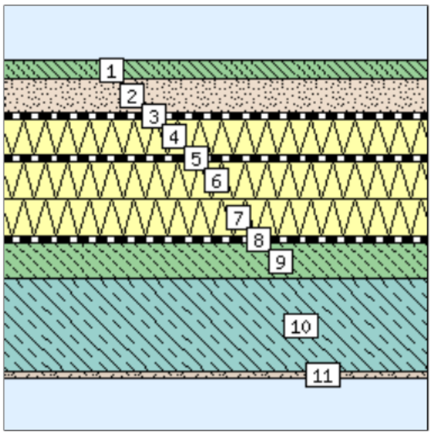
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Sand, Kies lufttrocken, Pflanzensubstrat	7,000	2,000	0,035	[1]3
2		Rock wool MW(SW)-W (100 kg/m³)	2,000	0,039	0,513	6
3		Flooring material - sand and gravel (1700 kg/m³)	9,000	2,000	0,045	[1]0
4		PE fleece	0,150	0,500	0,003	[1]2
5		URSA XPS N-III	10,000	0,040	2,500	21
6		Polymer bitumen sealing sheeting	1,000	0,230	0,043	[1]25
7		EPS-W 25 (23 kg/m³)	10,000	0,036	2,778	14
8		EPS-W 25 (23 kg/m³)	10,000	0,036	2,778	14
9		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[1]1
10		Cement and cement flowing screed (1800 kg/m³)	10,000	1,100	0,091	16
11		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
12		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,100 / 0,040	
		R' / R" (max. relative error: 0,0%) =			9,045 / 9,045	
		building element	**84,970**		**9,045**	**160**



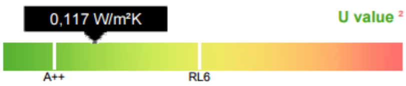
mass	**1061,5 kg/m²**	
EI_{KON}	1,25 points/m²	
PENRT	2.227,901 MJ/m²	**service life:** yes, integer
GWP100 total	148,126 kg CO_2/m²	**type:** new building
AP	0,455 kg SO_2/m²	

e7 - Paved roof

Ceiling, roof: Flat or pitched roof exposed to outside air – not back-ventilated – heat flow ascending



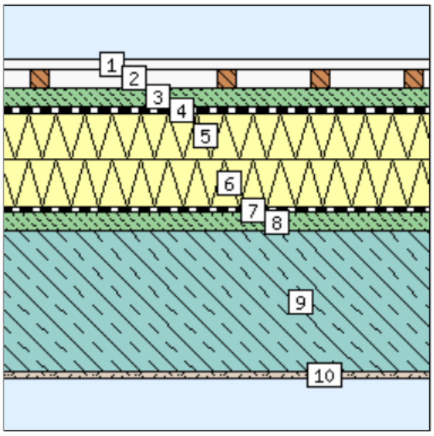
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal concrete without reinforcement (2000 kg/m³)	5,000	1,350	0,037	[1]6
2		Flooring material - sand and gravel (1700 kg/m³)	9,000	2,000	0,045	[1]0
3		PE fleece	0,150	0,500	0,003	[1]2
4		URSA XPS N-III	10,000	0,040	2,500	21
5		Polymer bitumen sealing sheeting	1,000	0,230	0,043	[1]25
6		EPS-W 25 (23 kg/m³)	10,000	0,036	2,778	14
7		EPS-W 25 (23 kg/m³)	10,000	0,036	2,778	14
8		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[1]1
9		Cement and cement flowing screed (1800 kg/m³)	10,000	1,100	0,091	16
10		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
11		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,100 / 0,040	
		R' / R" (max. relative error: 0,0%) =			8,534 / 8,534	
		building element	**80,970**		**8,534**	**157**



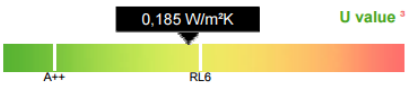
mass	**1040,5 kg/m²**	
EI_{KON}	1,18 points/m²	
PENRT	2.212,077 MJ/m²	**service life:** yes, integer
GWP100 total	151,196 kg CO_2/m²	**type:** new building
AP	0,437 kg SO_2/m²	

e1* - Terrace (on green roof)

Ceiling, roof: Flat or pitched roof exposed to outside air – not back-ventilated – heat flow ascending



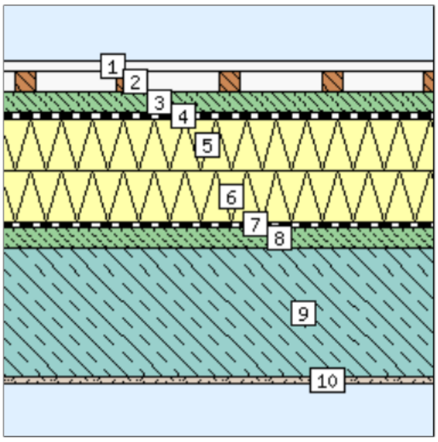
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		*inhomogeneous (parts parallel to the eaves)*	2,000			
		1 cm (9%) Vertical air layer, heat flow up 16 < d <= 20 m	2,000	[1]	[1]	[2]0
		10 cm (91%) Wooden floor, solid wood	2,000	[1]	[1]	[2]5
2		*inhomogeneous (parts normal to the eaves)*	4,000			
		16 cm (80%) Vertical air layer, heat flow up 36 < d <= 4(	4,000	[1]	[1]	[2]0
		4 cm (20%) Timber (475 kg/m³ - e.g. spruce/fir) - rough,	4,000	[1]	[1]	[2]1
3		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	[2]7
4		Polymer bitumen sealing sheeting	1,000	0,230	0,043	[2]25
5		URSA XPS N-III	10,000	0,040	2,500	21
6		URSA XPS N-III	10,000	0,040	2,500	21
7		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[2]1
8		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	7
9		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	30,000	2,300	0,130	69
10		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		0,3 kgEpoxidharz-Beschichtung				[2]5
		R_{si} / R_{se} =			0,100 / 0,040	
		R' / R" (max. relative error: 0,0%) =			5,397 / 5,397	
		building element	**65,820**		**5,397**	**161**



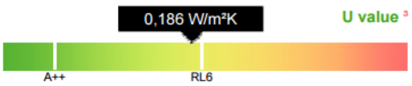
mass	**881,3 kg/m²**	
EI_{KON}	1,08 points/m²	
PENRT	2.242,360 MJ/m²	**service life:** yes, integer
GWP100 total	128,544 kg CO_2/m²	**type:** new building
AP	0,483 kg SO_2/m²	

e2 - Terrace (on green roof)

Ceiling, roof: Flat or pitched roof exposed to outside air – not back-ventilated – heat flow ascending



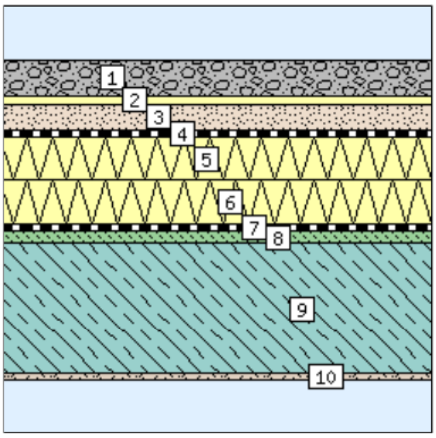
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		*inhomogeneous (parts parallel to the eaves)*	2,000			
		1 cm (9%) Vertical air layer, heat flow up 16 < d <= 20 m	2,000	[1]	[1]	[2]0
		10 cm (91%) Wooden floor, solid wood	2,000	[1]	[1]	[2]5
2		*inhomogeneous (parts normal to the eaves)*	4,000			
		16 cm (80%) Vertical air layer, heat flow up 36 < d <= 4(	4,000	[1]	[1]	[2]0
		4 cm (20%) Timber (475 kg/m³ - e.g. spruce/fir) - rough,	4,000	[1]	[1]	[2]-0
3		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	[2]7
4		Polymer bitumen sealing sheeting	1,000	0,230	0,043	[2]25
5		URSA XPS N-III	10,000	0,040	2,500	21
6		URSA XPS N-III	10,000	0,040	2,500	21
7		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[2]1
8		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	7
9		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
10		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
	0,3 kgEpoxidharz-Beschichtung					5
		R_{si} / R_{se} =			0,100 / 0,040	
		R' / R" (max. relative error: 0,0%) =			5,376 / 5,376	
		building element	**60,820**		**5,376**	**148**



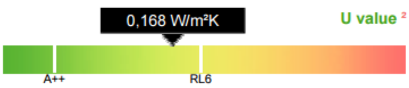
mass	**766,3 kg/m²**	
EI_{KON}	1,03 points/m²	
PENRT	2.101,721 MJ/m²	**service life:** yes, integer
GWP100 total	113,264 kg CO_2/m²	**type:**
AP	0,444 kg SO_2/m²	new building

e9 - Terrace (greening 10. floor)

Ceiling, roof: Flat or pitched roof exposed to outside air – not back-ventilated – heat flow ascending



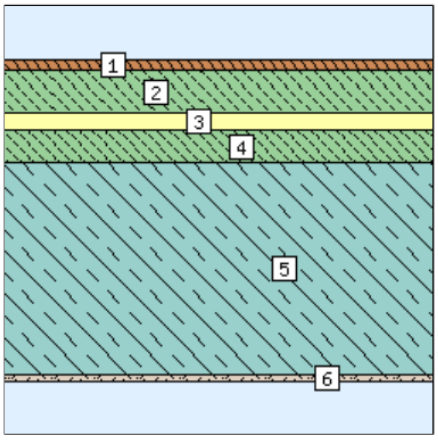
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Sand, Kies lufttrocken, Pflanzensubstrat	8,000	2,000	0,040	[1]3
2		Rock wool MW(SW)-W (100 kg/m³)	2,000	0,039	0,513	6
3		Flooring material - sand and gravel (1700 kg/m³)	6,000	2,000	0,030	[1]0
4		PE fleece	0,150	0,500	0,003	[1]2
5		URSA XPS N-III	10,000	0,040	2,500	21
6		URSA XPS N-III	10,000	0,040	2,500	21
7		Polymer bitumen sealing sheeting	1,000	0,230	0,043	[1]25
8		Cement and cement flowing screed (1800 kg/m³)	3,000	1,100	0,027	5
9		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	30,000	2,300	0,130	69
10		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,100 / 0,040	
		R' / R" (max. relative error: 0,0%) =			5,937 / 5,937	
		building element	**70,950**		**5,937**	**153**



mass	**1015,3 kg/m²**	
EI_{KON}	1,02 points/m²	
PENRT	2.096,144 MJ/m²	**service life:** yes, integer
GWP100 total	143,245 kg CO_2/m²	**type:**
AP	0,441 kg SO_2/m²	new building

a1 - Floors in apartments

Floor: within heated residential and office unit not subject to a U-value requirement

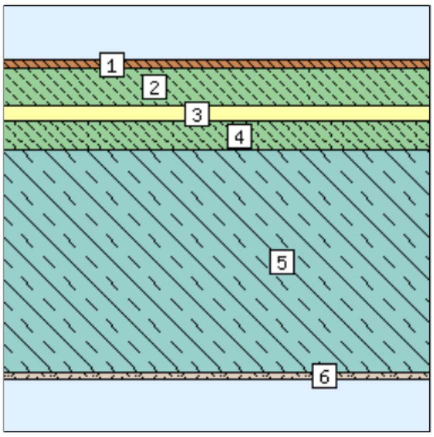


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Solid parquet	1,200	0,160	0,075	24
2		Cement and cement flowing screed (1800 kg/m³)	5,000	1,100	0,045	8
3		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
4		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
5		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
6		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		1,3 kgPolyurethane adhesive				8
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			1,454 / 1,454	
		building element	**38,000**		**1,454**	**119**

U value:	**0,688 W/m²K**	
mass	**713,6 kg/m²**	
EI_{KON}	0,67 points/m²	
PENRT	1.461,432 MJ/m²	**service life:** yes, integer
GWP100 total	117,181 kg CO_2/m²	**type:**
AP	0,382 kg SO_2/m²	new building

a1* - Floors in apartments (10. floor)

Floor: within heated residential and office unit not subject to a U-value requirement

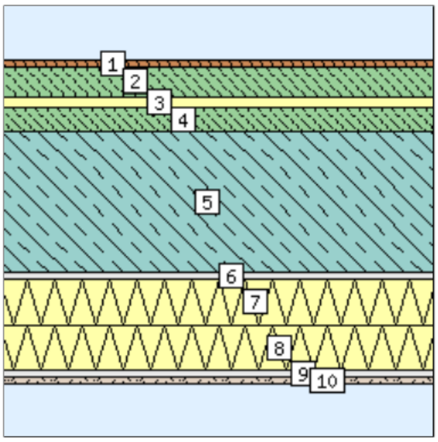


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Solid parquet	1,200	0,160	0,075	24
2		Cement and cement flowing screed (1800 kg/m³)	5,000	1,100	0,045	8
3		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
4		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
5		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	30,000	2,300	0,130	69
6		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		1,3 kgPolyurethane adhesive				8
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			1,476 / 1,476	
		building element	**43,000**		**1,476**	**131**

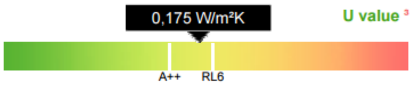
U value:	**0,677 W/m²K**	
mass	**828,6 kg/m²**	
EI_{KON}	0,72 points/m²	
PENRT	1.592,510 MJ/m²	**service life:** yes, integer
GWP100 total	131,887 kg CO_2/m²	**type:**
AP	0,417 kg SO_2/m²	new building

a2 - Floors in apartments exposed to outside air

Floor: exposed to outside air – not back-ventilated – heat flow descending



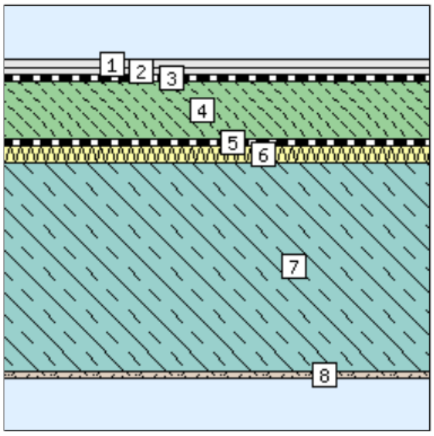
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Solid parquet	1,200	0,160	0,075	[1]24
2		Cement and cement flowing screed (1800 kg/m³)	5,000	1,100	0,045	8
3		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
4		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
5		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
6		Mineral adhesive	0,300	1,000	0,003	2
7		Kl Putzträgerplatte FKD-S C1	8,000	0,036	2,222	33
8		Kl Putzträgerplatte FKD-S C1	8,000	0,036	2,222	33
9		Mineral adhesive	0,600	1,000	0,006	3
10		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		1,3 kgPolyurethane adhesive				[1]4
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R'' (max. relative error: 0,0%) =			5,730 / 5,730	
		building element	**54,300**		**5,730**	**187**



mass	**743,0 kg/m²**		
EI_{KON}	1,33 points/m²		
PENRT	1.957,281 MJ/m²	**service life:** yes, integer	
GWP100 total	163,594 kg CO_2/m²	**type:** new building	
AP	0,711 kg SO_2/m²		

a3 - Floors in sanitary facilities

Floor: within heated residential and office unit not subject to a U-value requirement

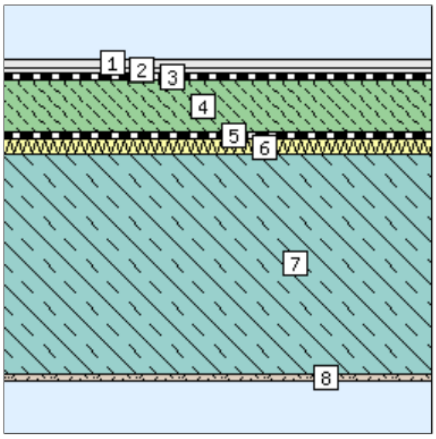


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	[1]43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Polymer bitumen sealing sheeting	0,500	0,230	0,022	25
4		Cement and cement flowing screed (1800 kg/m³)	7,000	1,100	0,064	12
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
6		Polyethylene foam (70 kg/m³)	2,000	0,050	0,400	14
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			0,957 / 0,957	
		building element	**36,820**		**0,957**	**159**

U value:	**1,044 W/m²K** [2]		
mass	**752,8 kg/m²**		
EI_{KON}	0,73 points/m²		
PENRT	2.199,031 MJ/m²	**service life:** yes, integer	
GWP100 total	150,003 kg CO_2/m²	**type:** new building	
AP	0,455 kg SO_2/m²		

a3* - Floors in sanitary facilities (10. floor)

Floor: within heated residential and office unit not subject to a U-value requirement

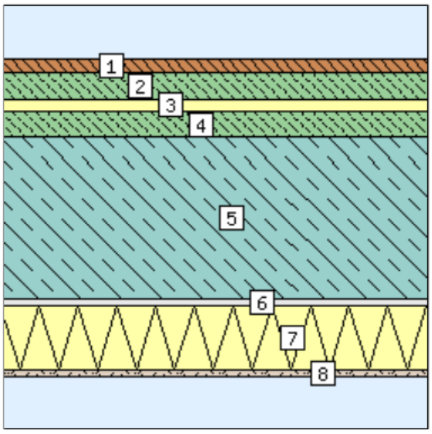


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	[1]43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Polymer bitumen sealing sheeting	0,500	0,230	0,022	25
4		Cement and cement flowing screed (1800 kg/m³)	7,000	1,100	0,064	12
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
6		Polyethylene foam (70 kg/m³)	2,000	0,050	0,400	14
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	30,000	2,300	0,130	69
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =		0,170 / 0,170		
		R' / R'' (max. relative error: 0,0%) =		0,979 / 0,979		
		building element	**41,820**		**0,979**	**170**

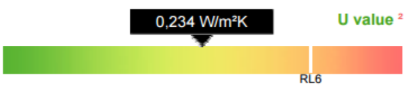
U value:	**1,021 W/m²K** [2]	
mass	**867,8 kg/m²**	
EI_{KON}	0,78 points/m²	
PENRT	2.330,110 MJ/m²	**service life:** yes, integer
GWP100 total	164,709 kg CO_2/m²	**type:** new building
AP	0,490 kg SO_2/m²	

a4 - Floors in apartment above restaurant

Floor: exposed to separated and heated residential and office units – heat flow descending



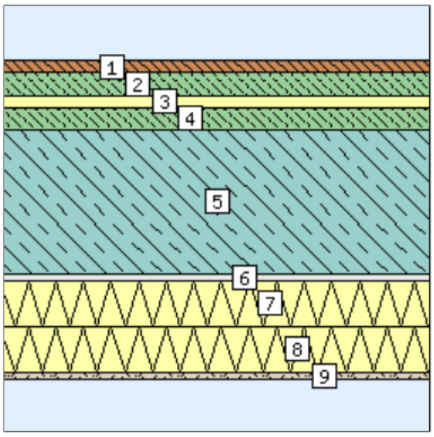
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Solid parquet	2,100	0,160	0,131	[1]42
2		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	7
3		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
4		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
5		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
6		Mineral adhesive	0,300	1,000	0,003	2
7		KI Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 8 cm				[1]1
		1,3 kgPolyurethane adhesive				[1]8
		R_{si} / R_{se} =		0,170 / 0,170		
		R' / R'' (max. relative error: 0,0%) =		4,282 / 4,282		
		building element	**48,200**		**4,282**	**179**



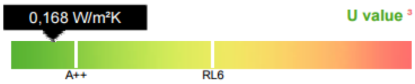
mass	**721,6 kg/m²**	
EI_{KON}	1,10 points/m²	
PENRT	2.008,757 MJ/m²	**service life:** yes, integer
GWP100 total	150,761 kg CO_2/m²	**type:** new building
AP	0,650 kg SO_2/m²	

a4 - Floors in apartment above unheated space

Floor: exposed to unheated parts of buildings – heat flow descending



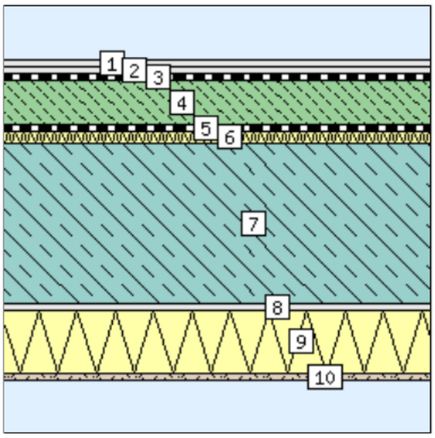
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Solid parquet	2,100	0,160	0,131	[1]42
2		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	7
3		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
4		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
5		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
6		Mineral adhesive	0,300	1,000	0,003	2
7		Kl Putzträgerplatte FKD-S C1	8,000	0,036	2,222	33
8		Kl Putzträgerplatte FKD-S C1	8,000	0,036	2,222	33
9		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		1,3 kgPolyurethane adhesive				[1]8
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			5,949 / 5,949	
		building element	**54,200**		**5,949**	**205**



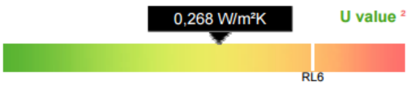
mass	**730,0 kg/m²**	
EI_{KON}	1,34 points/m²	
PENRT	2.204,874 MJ/m²	**service life:** yes, integer
GWP100 total	168,101 kg CO_2/m²	**type:** new building
AP	0,774 kg SO_2/m²	

a5 - Floors in sanitary facilities above restaurant

Floor: exposed to separated and heated residential and office units – heat flow descending



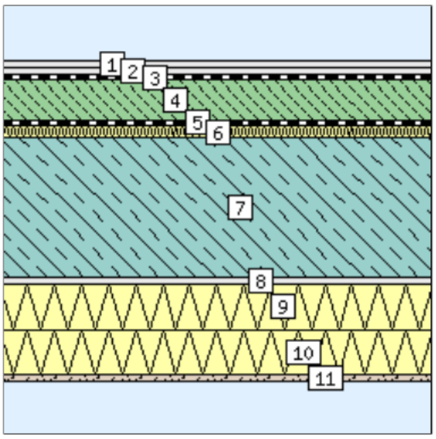
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	[1]43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Polymer bitumen sealing sheeting	0,500	0,230	0,022	25
4		Cement and cement flowing screed (1800 kg/m³)	7,000	1,100	0,064	12
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
6		Polyethylene foam (70 kg/m³)	2,000	0,050	0,400	14
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Mineral adhesive	0,300	1,000	0,003	2
9		Kl Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
10		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 8 cm				[1]1
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			3,738 / 3,738	
		building element	**47,120**		**3,738**	**202**



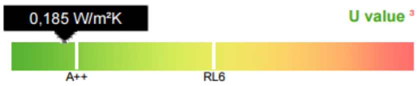
mass	**772,2 kg/m²**	
EI_{KON}	1,14 points/m²	
PENRT	2.528,201 MJ/m²	**service life:** yes, integer
GWP100 total	179,446 kg CO_2/m²	**type:** new building
AP	0,660 kg SO_2/m²	

a5 - Floors in sanitary facilities above unheated space

Floor: exposed to unheated parts of buildings – heat flow descending



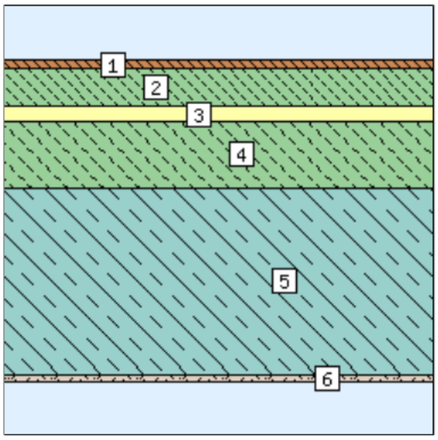
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Polymer bitumen sealing sheeting	0,500	0,230	0,022	25
4		Cement and cement flowing screed (1800 kg/m³)	7,000	1,100	0,064	12
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
6		Polyethylene foam (70 kg/m³)	2,000	0,050	0,400	14
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Mineral adhesive	0,300	1,000	0,003	2
9		KI Putzträgerplatte FKD-S C1	8,000	0,036	2,222	33
10		KI Putzträgerplatte FKD-S C1	8,000	0,036	2,222	33
11		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				2
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			5,405 / 5,405	
		building element	**53,120**		**5,405**	**228**



mass	**780,6 kg/m²**	
EI_{KON}	1,38 points/m²	
PENRT	2.724,318 MJ/m²	**service life:** yes, integer
GWP100 total	196,786 kg CO_2/m²	**type:** new building
AP	0,783 kg SO_2/m²	

a6 - Floors in apartments (11. floor)

Floor: within heated residential and office unit not subject to a U-value requirement

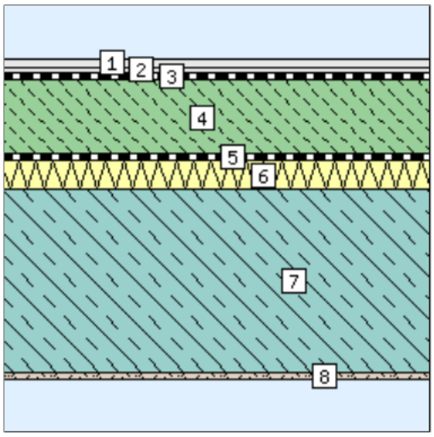


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Solid parquet	1,200	0,160	0,075	24
2		Cement and cement flowing screed (1800 kg/m³)	5,000	1,100	0,045	8
3		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
4		Concrete with EPS aggregate (600 kg/m³)	9,000	0,160	0,563	30
5		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
6		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		1,3 kgPolyurethane adhesive				8
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			1,767 / 1,767	
		building element	**43,000**		**1,767**	**136**

U value:	**0,566 W/m²K** 2	
mass	**743,6 kg/m²**	
EI_{KON}	0,82 points/m²	
PENRT	1.670,092 MJ/m²	**service life:** yes, integer
GWP100 total	133,211 kg CO_2/m²	**type:** new building
AP	0,436 kg SO_2/m²	

a7 - Floors in sanitary facilities (11. floor)

Floor: within heated residential and office unit not subject to a U-value requirement

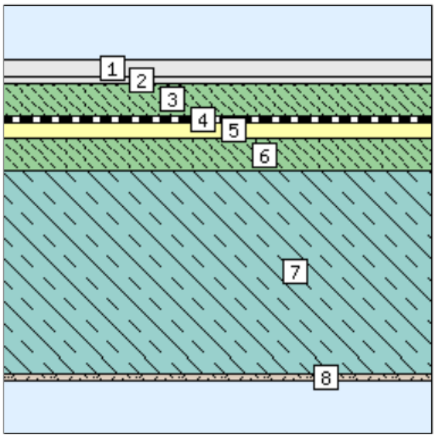


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Polymer bitumen sealing sheeting	0,500	0,230	0,022	25
4		Cement and cement flowing screed (1800 kg/m³)	10,000	1,100	0,091	16
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
6		Polyethylene foam (70 kg/m³)	4,000	0,050	0,800	28
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =		0,170 / 0,170		
		R' / R'' (max. relative error: 0,0%) =		1,385 / 1,385		
		building element	**41,820**		**1,385**	**178**

U value:	**0,722 W/m²K**	
mass	**808,2 kg/m²**	
EI_{KON}	0,97 points/m²	
PENRT	2.501,359 MJ/m²	**service life:** yes, integer
GWP100 total	164,498 kg CO_2/m²	**type:** new building
AP	0,503 kg SO_2/m²	

b1 - Floor in hallway

Floor: within heated residential and office unit not subject to a U-value requirement

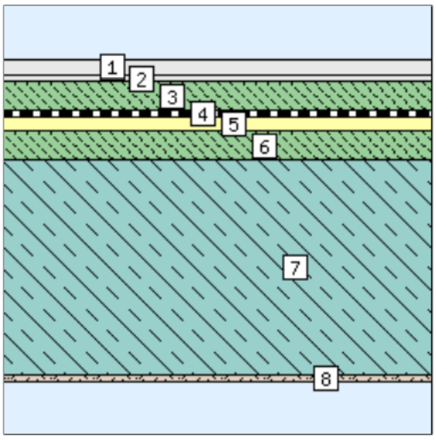


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Granite (2700 kg/m³)	2,000	3,400	0,006	45
2		Mineral adhesive	0,500	1,000	0,005	6
3		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	7
4		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
5		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
6		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =		0,170 / 0,170		
		R' / R'' (max. relative error: 0,0%) =		1,382 / 1,382		
		building element	**38,320**		**1,382**	**137**

U value:	**0,724 W/m²K**	
mass	**748,5 kg/m²**	
EI_{KON}	0,64 points/m²	
PENRT	1.568,333 MJ/m²	**service life:** yes, integer
GWP100 total	137,740 kg CO_2/m²	**type:** new building
AP	0,461 kg SO_2/m²	

b1 - Floor in hallway (10. floor)

Floor: within heated residential and office unit not subject to a U-value requirement

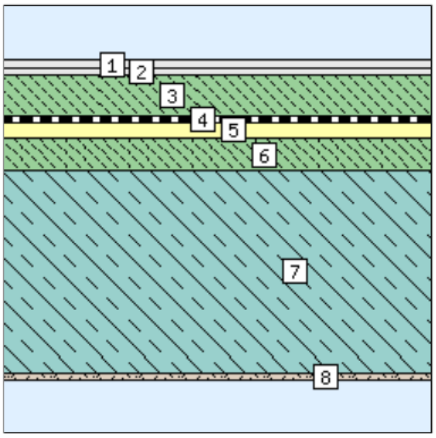


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Granite (2700 kg/m³)	2,000	3,400	0,006	45
2		Mineral adhesive	0,500	1,000	0,005	6
3		Cement and cement flowing screed (1800 kg/m³)	4,000	1,100	0,036	7
4		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
5		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
6		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	30,000	2,300	0,130	69
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =		0,170 / 0,170		
		R' / R'' (max. relative error: 0,0%) =		1,403 / 1,403		
		building element	**43,320**		**1,403**	**148**

U value:	**0,713 W/m²K**		
mass	**863,5 kg/m²**		
EI_{KON}	0,69 points/m²		
PENRT	1.699,412 MJ/m²	**service life:** yes, integer	
GWP100 total	152,447 kg CO_2/m²		
AP	0,495 kg SO_2/m²	**type:** new building	

b1 - Floor in service area (Storey)

Floor: within heated residential and office unit not subject to a U-value requirement

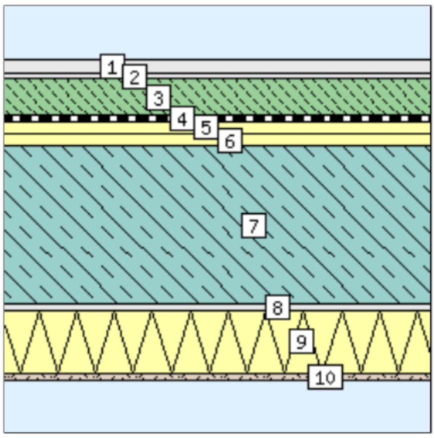


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Cement and cement flowing screed (1800 kg/m³)	5,000	1,100	0,045	8
4		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
5		URSA Trittschalldämmplatte TSP	2,000	0,032	0,625	6
6		Concrete with EPS aggregate (600 kg/m³)	4,000	0,160	0,250	13
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =		0,170 / 0,170		
		R' / R'' (max. relative error: 0,0%) =		1,392 / 1,392		
		building element	**38,320**		**1,392**	**137**

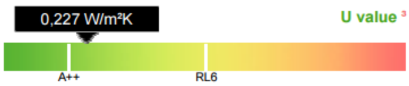
U value:	**0,718 W/m²K**		
mass	**735,5 kg/m²**		
EI_{KON}	0,66 points/m²		
PENRT	1.698,592 MJ/m²	**service life:** yes, integer	
GWP100 total	145,403 kg CO_2/m²		
AP	0,418 kg SO_2/m²	**type:** new building	

b10 - Floor in hallway (mezzanine)

Floor: exposed to unheated parts of buildings – heat flow descending



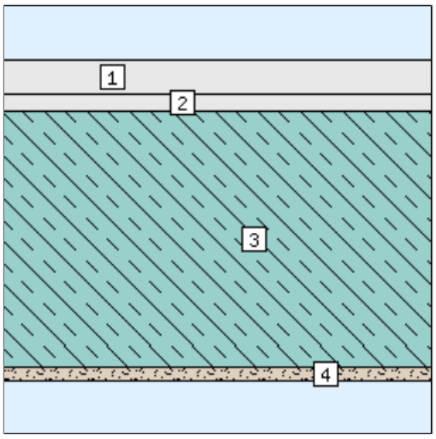
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Granite (2700 kg/m³)	2,000	3,400	0,006	45
2		Mineral adhesive	0,500	1,000	0,005	6
3		Cement and cement flowing screed (1800 kg/m³)	5,500	1,100	0,050	9
4		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
5		KI Trittschall-Dämmplatte TPS	2,000	0,036	0,556	8
6		KI Trittschall-Dämmplatte TPS	2,000	0,036	0,556	8
7		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
8		Mineral adhesive	0,300	1,000	0,003	2
9		KI Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
10		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
additional materials (thermally not relevant): (quantity per m² building element)						
		0 pComplete dowel 8 cm				0
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			4,412 / 4,412	
		building element	**48,120**		**4,412**	**177**



mass	**774,5 kg/m²**	
EI_{KON}	0,98 points/m²	
PENRT	1.787,324 MJ/m²	**service life:** yes, integer
GWP100 total	163,221 kg CO_2/m²	**type:** new building
AP	0,677 kg SO_2/m²	

b4 - Floor in staircase (landing)

Floor: within heated residential and office unit not subject to a U-value requirement

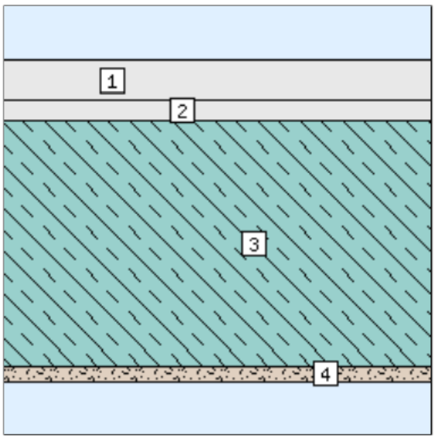


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Granite (2700 kg/m³)	2,000	3,400	0,006	45
2		Mineral adhesive	1,000	1,000	0,010	12
3		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	15,000	2,300	0,065	34
4		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			0,431 / 0,431	
		building element	**18,800**		**0,431**	**92**

U value:	**2,318 W/m²K**	
mass	**429,8 kg/m²**	
EI_{KON}	0,18 points/m²	
PENRT	1.053,443 MJ/m²	**service life:** yes, integer
GWP100 total	88,716 kg CO_2/m²	**type:** new building
AP	0,319 kg SO_2/m²	

b5 - Floor in staircase (stairs)

Floor: within heated residential and office unit not subject to a U-value requirement

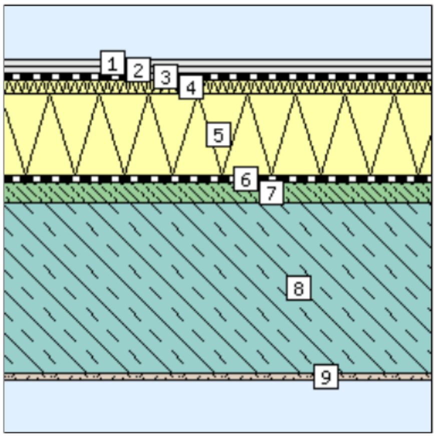


no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Granite (2700 kg/m³)	2,000	3,400	0,006	45
2		Mineral adhesive	1,000	1,000	0,010	12
3		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	12,500	2,300	0,054	29
4		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,170 / 0,170	
		R' / R'' (max. relative error: 0,0%) =			0,420 / 0,420	
		building element	**16,300**		**0,420**	**87**

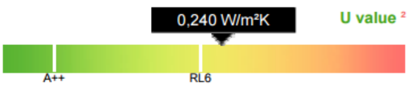
U value:	**2,378 W/m²K** [2]	
mass	**372,3 kg/m²**	
EI_{KON}	0,16 points/m²	
PENRT	987,903 MJ/m²	**service life:** yes, integer
GWP100 total	81,362 kg CO_2/m²	**type:**
AP	0,301 kg SO_2/m²	new building

e4 - Loggia above heated area

Ceiling, roof: Flat or pitched roof exposed to outside air – not back-ventilated – heat flow ascending



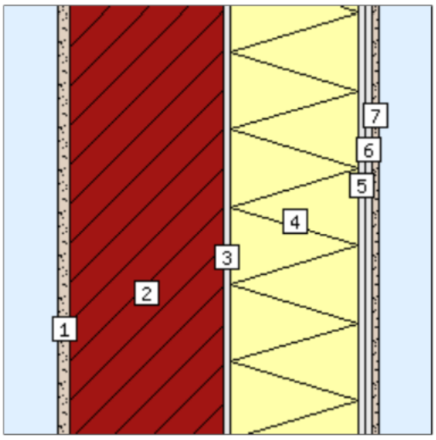
no.	type	layer	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Ceramic tiles (2300 kg/m³)	1,000	1,300	0,008	43
2		Mineral adhesive	0,500	1,000	0,005	6
3		Polymer bitumen sealing sheeting	0,800	0,230	0,035	40
4		XPS–G 20 20 to 60 mm (32 kg/m³)	2,000	0,040	0,500	4
5		EPS-W 25 (23 kg/m³)	12,000	0,036	3,333	16
6		Polyethylene (PE) vapour brake	0,020	0,500	0,000	1
7		Cement and cement flowing screed (1800 kg/m³)	3,000	1,100	0,027	5
8		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	25,000	2,300	0,109	57
9		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	2
		R_{si} / R_{se} =			0,100 / 0,040	
		R' / R'' (max. relative error: 0,0%) =			4,167 / 4,167	
		building element	**45,120**		**4,167**	**174**



mass	**686,1 kg/m²**	
EI_{KON}	0,71 points/m²	
PENRT	2.485,553 MJ/m²	**service life:** yes, integer
GWP100 total	152,954 kg CO_2/m²	**type:**
AP	0,489 kg SO_2/m²	new building

Brick - External wall (loggia)

Wall: exposed to outside air – not back-ventilated

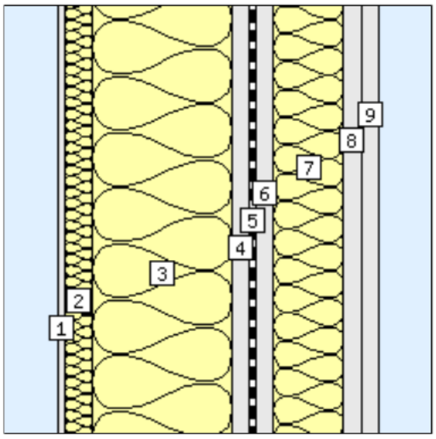


no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Vertically perforated brick 17 cm to 38 cm + normal mort	19,000	0,280	0,679	29
3		Mineral adhesive	0,300	1,000	0,003	2
4		KI Putzträgerplatte FKD-S C1	16,000	0,036	4,444	65
5		Glass-fibre reinforcement	0,010	0,200	0,001	0
6		Mineral adhesive	0,600	1,000	0,006	3
7		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		R_{si} / R_{se} =		0,130 / 0,040		
		R' / R" (max. relative error: 0,0%) =		5,324 / 5,324		
		building element	**37,610**		**5,324**	**106**

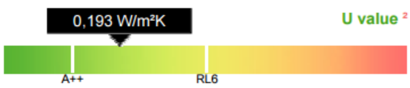
mass	**232,6 kg/m²**	
EI_{KON}	0,80 points/m²	
PENRT	1.001,772 MJ/m²	**service life:** yes, integer
GWP100 total	85,477 kg CO_2/m²	**type:**
AP	0,438 kg SO_2/m²	new building

Installation shaft

Wall: exposed to outside air – not back-ventilated



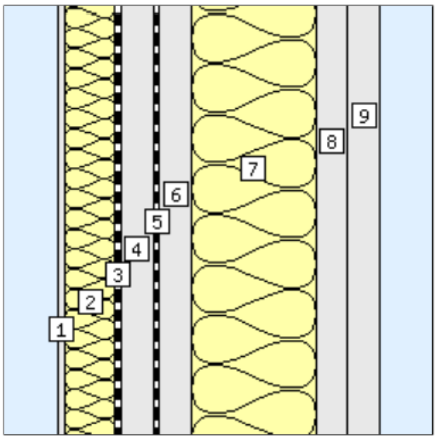
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Steel sheet, galvanised	0,170	50,000	0,000	[1]37
2		Foam rubber (60 kg/m³)	2,000	0,060	0,333	12
3		KI Zwischensparren-Dämmrolle UNIFIT TI 132 U	10,000	0,032	3,125	13
4		Knauf Fireboard	1,250	0,250	0,050	4
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[1]1
6		Knauf Fireboard	1,250	0,250	0,050	4
7		KI Trennwand-Dämmrolle TI 140 W	5,000	0,037	1,351	3
8		Knauf Fireboard	1,250	0,250	0,050	4
9		Knauf Fireboard	1,250	0,250	0,050	4
		R_{si} / R_{se} =		0,130 / 0,040		
		R' / R" (max. relative error: 0,0%) =		5,180 / 5,180		
		building element	**22,190**		**5,180**	**81**



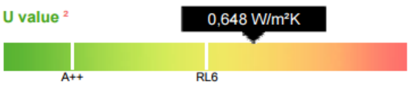
mass	**57,5 kg/m²**	
EI_{KON}	0,75 points/m²	
PENRT	1.031,648 MJ/m²	**service life:** yes, integer
GWP100 total	48,598 kg CO_2/m²	**type:**
AP	0,288 kg SO_2/m²	new building

installation shaft (Alu foil 12%)

Wall: exposed to outside air – not back-ventilated



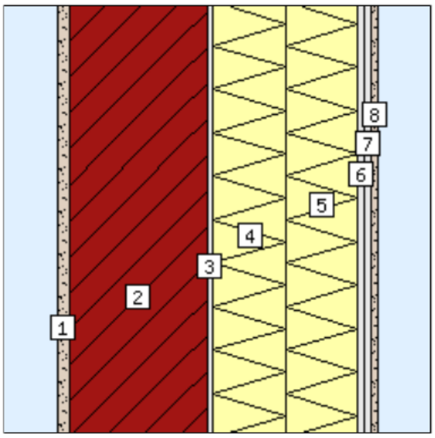
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Steel sheet, galvanised	0,170	50,000	0,000	[1]37
2		Foam rubber (60 kg/m³)	2,000	0,060	0,333	12
3		Aluminium foil	0,100	221,000	0,000	[1]126
4		Knauf Fireboard	1,250	0,250	0,050	4
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[1]1
6		Knauf Fireboard	1,250	0,250	0,050	4
7		*inhomogeneous (parts horizontal)*	5,000			
		89,8 cm (100%) KI Trennwand-Dämmrolle TI 140 W	5,000	0,037	1,351	3
		0,2 cm (0%) Steel sheet, galvanised	5,000	50,000	0,001	2
8		Knauf Fireboard	1,250	0,250	0,050	4
9		Knauf Fireboard	1,250	0,250	0,050	4
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R'' (max. relative error: 32,5%) =			2,046 / 1,042	
		building element	**12,290**		**1,544**	**196**



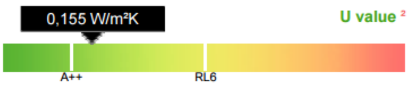
mass	**58,0 kg/m²**	
EI_{KON}	0,46 points/m²	
PENRT	2.456,057 MJ/m²	**service life:** yes, integer
GWP100 total	135,277 kg CO_2/m²	**type:** new building
AP	0,688 kg SO_2/m²	

p1 - Contact Facade

Wall: exposed to outside air – not back-ventilated



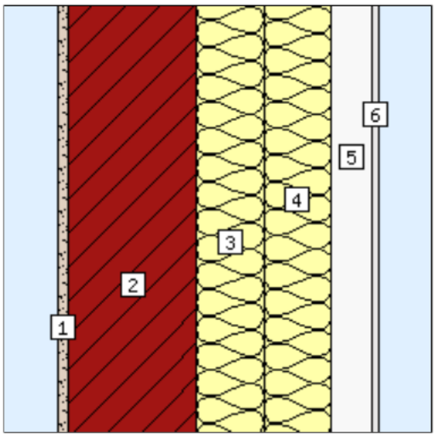
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Vertically perforated brick 17 cm to 38 cm + normal mort	19,000	0,280	0,679	29
3		Mineral adhesive	0,300	1,000	0,003	2
4		KI Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
5		KI Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
6		Glass-fibre reinforcement	0,010	0,200	0,001	0
7		Mineral adhesive	0,600	1,000	0,006	3
8		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R'' (max. relative error: 0,0%) =			6,435 / 6,435	
		building element	**41,610**		**6,435**	**122**



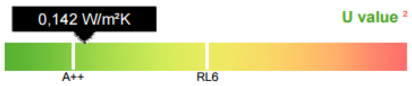
mass	**238,2 kg/m²**	
EI_{KON}	0,96 points/m²	
PENRT	1.121,402 MJ/m²	**service life:** yes, integer
GWP100 total	96,311 kg CO_2/m²	**type:** new building
AP	0,517 kg SO_2/m²	

p2 - Ventilated Facade

Wall: exposed to outside air – back-ventilated



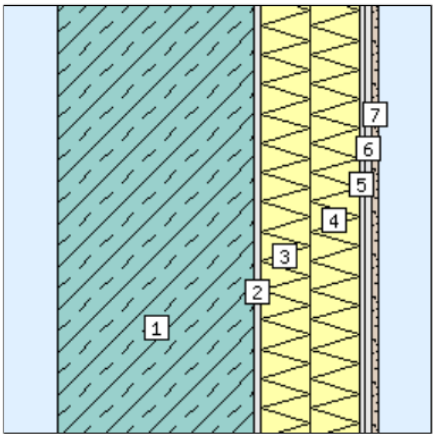
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Vertically perforated brick 17 cm to 38 cm + normal mor	19,000	0,280	0,679	29
3		KI Fassaden-Dämmplatte TP 435 B	10,000	0,034	2,941	10
4		KI Fassaden-Dämmplatte TP 435 B	10,000	0,034	2,941	10
5		Vertical air layer, horizontal heat flow 55 < d <= 60 mm	6,000	0,333	0,180	[1]0
6		RHEINZINK-Fassaden	0,100	[3]	[3]	[1]35
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		1,5 kgSteel anchors				[1]17
		R_{si} / R_{se} =			0,130 / 0,130	
		R' / R" (max. relative error: 0,0%) =			7,020 / 7,020	
		building element	**46,600**		**7,020**	**107**



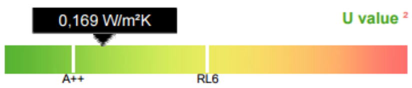
mass	**204,0 kg/m²**	
EI_{KON}	0,72 points/m²	
PENRT	1.064,134 MJ/m²	**service life:** yes, integer
GWP100 total	75,662 kg CO_2/m²	**type:** new building
AP	0,439 kg SO_2/m²	

p3a - External wall (staircase)

Wall: exposed to outside air – not back-ventilated



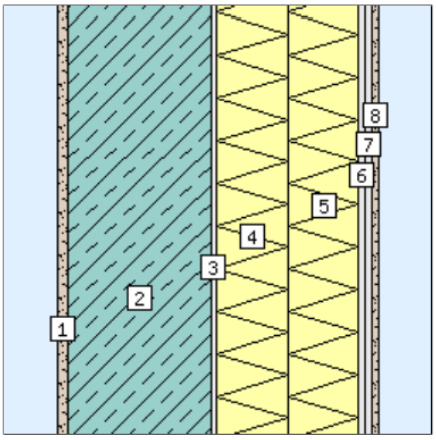
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	40,000	2,300	0,174	92
2		Mineral adhesive	0,300	1,000	0,003	2
3		KI Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
4		KI Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
5		Glass-fibre reinforcement	0,010	0,200	0,001	0
6		Mineral adhesive	0,600	1,000	0,006	3
7		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R" (max. relative error: 0,0%) =			5,911 / 5,911	
		building element	**61,110**		**5,911**	**182**



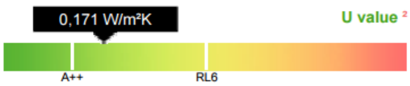
mass	**967,9 kg/m²**	
EI_{KON}	1,14 points/m²	
PENRT	1.755,468 MJ/m²	**service life:** yes, integer
GWP100 total	179,990 kg CO_2/m²	**type:** new building
AP	0,703 kg SO_2/m²	

RC20 - External wall

Wall: exposed to outside air – not back-ventilated



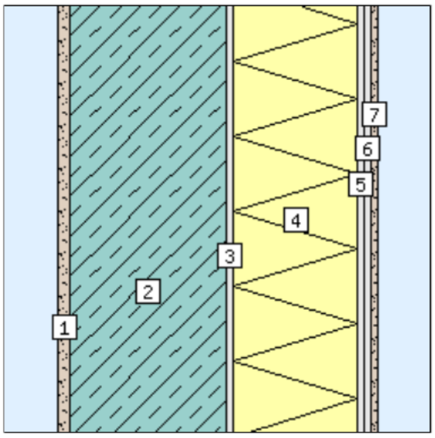
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	20,000	2,300	0,087	46
3		Mineral adhesive	0,300	1,000	0,003	2
4		Kl Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
5		Kl Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
6		Glass-fibre reinforcement	0,010	0,200	0,001	0
7		Mineral adhesive	0,600	1,000	0,006	3
8		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R'' (max. relative error: 0,0%) =			5,844 / 5,844	
		building element	**42,610**		**5,844**	**139**



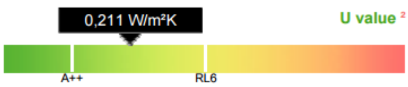
mass	**531,9 kg/m²**	
EI_{KON}	0,97 points/m²	
PENRT	1.263,892 MJ/m²	**service life:** yes, integer
GWP100 total	124,888 kg CO_2/m²	**type:**
AP	0,572 kg SO_2/m²	new building

RC20 - External wall (loggia)

Wall: exposed to outside air – not back-ventilated



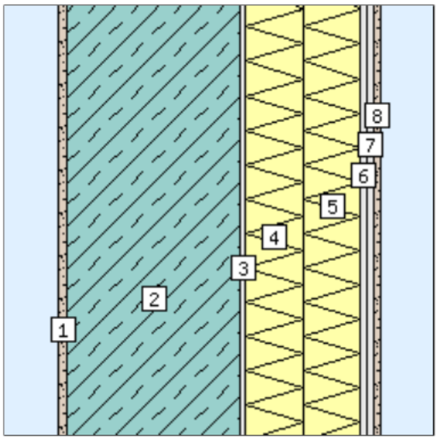
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	20,000	2,300	0,087	46
3		Mineral adhesive	0,300	1,000	0,003	2
4		Kl Putzträgerplatte FKD-S C1	16,000	0,036	4,444	65
5		Glass-fibre reinforcement	0,010	0,200	0,001	0
6		Mineral adhesive	0,600	1,000	0,006	3
7		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R'' (max. relative error: 0,0%) =			4,733 / 4,733	
		building element	**38,610**		**4,733**	**123**



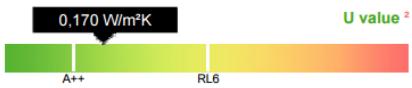
mass	**526,3 kg/m²**	
EI_{KON}	0,81 points/m²	
PENRT	1.144,262 MJ/m²	**service life:** yes, integer
GWP100 total	114,054 kg CO_2/m²	**type:**
AP	0,493 kg SO_2/m²	new building

RC30 - External wall

Wall: exposed to outside air – not back-ventilated



no.	type	**layer** (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	30,000	2,300	0,130	69
3		Mineral adhesive	0,300	1,000	0,003	2
4		Kl Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
5		Kl Putzträgerplatte FKD-S C1	10,000	0,036	2,778	41
6		Glass-fibre reinforcement	0,010	0,200	0,001	0
7		Mineral adhesive	0,600	1,000	0,006	3
8		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1] 2
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R" (max. relative error: 0,0%) =			5,887 / 5,887	
		building element	**52,610**		**5,887**	**162**



mass	**761,9 kg/m²**	
EI_{KON}	1,07 points/m²	
PENRT	1.526,050 MJ/m²	**service life:** yes, integer
GWP100 total	154,300 kg CO_2/m²	**type:** new building
AP	0,642 kg SO_2/m²	

Window (transparent element): Window or glass doors, glazed doors or other vertical transparent structural element respectively in residential buildings (RB) exposed to outside air, 3 wings

service life: yes, integer
Art: new building

U_w: [1]	width x height:	ΔOI3:	PENRT:	GWP100 S:	AP:
2,093 W/m²K	1,98 x 3,18 m	247 pts/m²	2.705,13 MJ/m²	188,3016 kg CO_2 equ./m²	0,941323 kg SO_2 equ./m²

component	title	indicator(s)	ΔOI3
glazing	Double-glazed heat-protection glass, Argon, pane thickness >= 24 mm	U_g = 1,150 W/m²K	56
window frame	Aluminium metal frame (with thermal separation)	U_f = 4,000 W/m²K frame width = 0,12 m	191
ψ (linear heat transfer coefficient)	reference (Aluminium (2-IV; Ug 1.4 - 1.9; Uf 1.4 - 2.1))	ψ = 0,060 W/mK	

Window (transparent element): Window or glass doors, glazed doors or other vertical transparent structural element respectively in residential buildings (RB) exposed to outside air, 2 wings

service life: yes, integer
Art: new building

U_w:[1]	width x height:	ΔOI3:	PENRT:	GWP100 S:	AP:
2,170 W/m²K	1,37 x 3,18 m	258 pts/m²	2.835,61 MJ//m²	196,9924 kg CO_2 equ.//m²	0,976246 kg SO_2 equ.//m²

component	title	indicator(s)	ΔOI3
glazing	Double-glazed heat-protection glass, Argon, pane thickness >= 24 mm	U_g = 1,150 W/m²K	55
window frame	Aluminium metal frame (with thermal separation)	U_f = 4,000 W/m²K frame width = 0,12 m	203
ψ (linear heat transfer coefficient)	reference (Aluminium (2-IV; Ug 1.4 - 1.9; Uf 1.4 - 2.1))	ψ = 0,060 W/mK	

Window (transparent element): Window or glass doors, glazed doors or other vertical transparent structural element respectively in residential buildings (RB) exposed to outside air, 1 wing

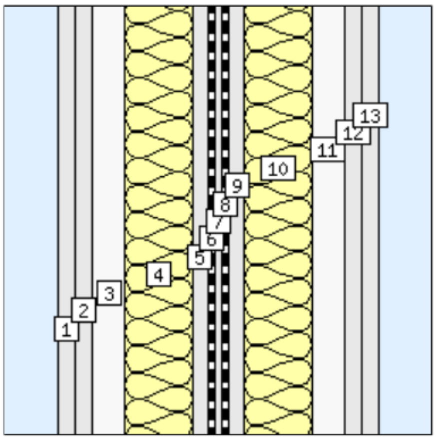
service life: yes, integer
Art: new building

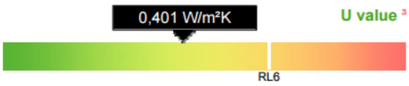
U_w:[1]	width x height:	ΔOI3:	PENRT:	GWP100 S:	AP:
0,938 W/m²K	1,4 x 2,3 m	196 pts/m²	2.109,27 MJ//m²	113,1695 kg CO_2 equ.//m²	0,798127 kg SO_2 equ.//m²

component	title	indicator(s)	ΔOI3
glazing	Triple-glazed heat-protection glass, Argon, 32 < pane thickness <= 40	U_g = 0,750 W/m²K	90
window frame	Highly heat-insulating aluminium frame	U_f = 1,100 W/m²K frame width = 0,15 m	105
ψ (linear heat transfer coefficient)	reference (Plastic/butyl (2-IV; Ug <1.4; Uf <1.4))	ψ = 0,040 W/mK	

p5 - Partition wall (apartment-hallway)

Wall: Partition wall between residential or office units



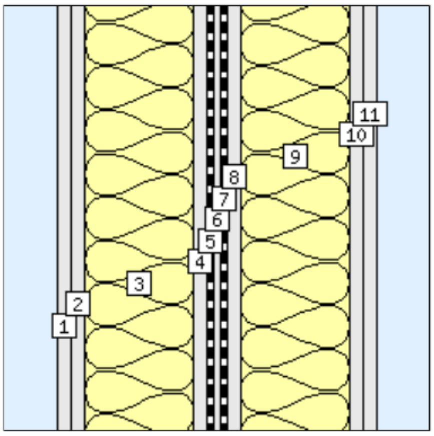


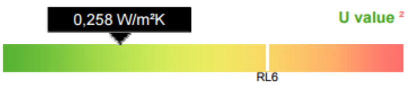
mass	66,8 kg/m²	
EI_{KON}	0,43 points/m²	
PENRT	612,560 MJ/m²	**service life:** yes, integer
GWP100 total	23,328 kg CO_2/m²	**type:** new building
AP	0,181 kg SO_2/m²	

no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Knauf Fireboard	1,250	0,250	0,050	[2]4
2		Knauf Fireboard	1,250	0,250	0,050	[2]4
3		*inhomogeneous (parts horizontal)*	2,500			
		89,8 cm (100%) Vertical air layer, horizontal heat flow 2(	2,500	0,147	0,170	[2]0
		0,2 cm (0%) Steel sheet, galvanised	2,500	50,000	0,001	[2]1
4		*inhomogeneous (parts horizontal)*	5,000			
		89,8 cm (100%) Kl Trennwand-Dämmrolle Tl 140 W	5,000	0,037	1,351	[2]3
		0,2 cm (0%) Steel sheet, galvanised	5,000	50,000	0,001	[2]2
5		Knauf Fireboard	1,250	0,250	0,050	[2]4
6		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[2]1
7		Steel sheet, galvanised	0,050	50,000	0,000	[2]11
8		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[2]1
9		Knauf Fireboard	1,250	0,250	0,050	[2]4
10		*inhomogeneous (parts horizontal)*	5,000			
		89,8 cm (100%) Kl Trennwand-Dämmrolle Tl 140 W	5,000	0,037	1,351	[2]3
		0,2 cm (0%) Steel sheet, galvanised	5,000	50,000	0,001	[2]2
11		*inhomogeneous (parts horizontal)*	2,500			
		89,8 cm (100%) Vertical air layer, horizontal heat flow 2(	2,500	0,147	0,170	[2]0
		0,2 cm (0%) Steel sheet, galvanised	2,500	50,000	0,001	[2]1
12		Knauf Fireboard	1,250	0,250	0,050	[2]4
13		Knauf Fireboard	1,250	0,250	0,050	[2]4
		R_{si} / R_{se} =		0,130 / 0,130		
		R' / R'' (max. relative error: 42,7%) =		3,561 / 1,430		
		building element	**22,590**		**2,496**	**48**

p6 - Partition wall (apartment-apartment)

Wall: Partition wall between residential or office units



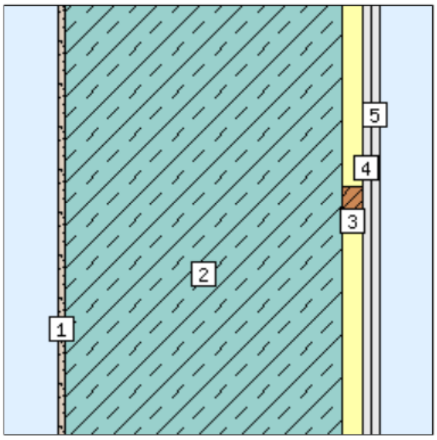


mass	69,1 kg/m²	
EI_{KON}	0,73 points/m²	
PENRT	708,856 MJ/m²	**service life:** yes, integer
GWP100 total	28,851 kg CO_2/m²	**type:** new building
AP	0,213 kg SO_2/m²	

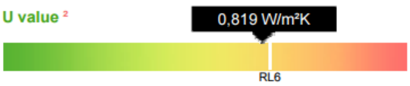
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Knauf Fireboard	1,250	0,250	0,050	[1]4
2		Knauf Fireboard	1,250	0,250	0,050	[1]4
3		*inhomogeneous (parts horizontal)*	10,000			
		89,8 cm (100%) Kl Trennwand-Dämmrolle Tl 140 W	10,000	0,037	2,703	[1]6
		0,2 cm (0%) Steel sheet, galvanised	10,000	50,000	0,002	[1]5
4		Knauf Fireboard	1,250	0,250	0,050	[1]4
5		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[1]1
6		Steel sheet, galvanised	0,050	50,000	0,000	[1]11
7		Polyethylene (PE) vapour brake	0,020	0,500	0,000	[1]1
8		Knauf Fireboard	1,250	0,250	0,050	[1]4
9		*inhomogeneous (parts horizontal)*	10,000			
		89,8 cm (100%) Kl Trennwand-Dämmrolle Tl 140 W	10,000	0,037	2,703	[1]6
		0,2 cm (0%) Steel sheet, galvanised	10,000	50,000	0,002	[1]5
10		Knauf Fireboard	1,250	0,250	0,050	[1]4
11		Knauf Fireboard	1,250	0,250	0,050	[1]4
		R_{si} / R_{se} =		0,130 / 0,130		
		R' / R'' (max. relative error: 50,7%) =		5,842 / 1,912		
		building element	**27,590**		**3,877**	**57**

RC partition wall (staircase-apartment)

Wall: Partition wall between residential or office units



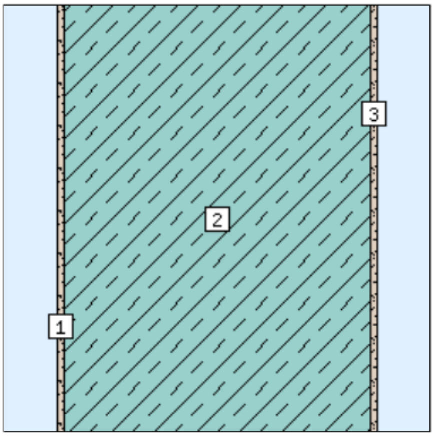
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	[1]2
2		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	40,000	2,300	0,174	[1]92
3		*inhomogeneous (parts vertical)*	3,000			
		45 cm (90%) Glass wool MW(GW)-W (18 kg/m³)	3,000	0,038	0,789	[1]2
		5 cm (10%) Timber (475 kg/m³ - e.g. spruce/fir) - rough,	3,000	0,120	0,250	[1]-0
4		Knauf Fireboard	1,250	0,250	0,050	[1]4
5		Knauf Fireboard	1,250	0,250	0,050	[1]4
		R_{si} / R_{se} =			0,130 / 0,130	
		R' / R" (max. relative error: 2,3%) =			1,249 / 1,194	
		building element	**46,300**		**1,221**	**103**



mass	**954,2 kg/m²**	
EI_{KON}	0,47 points/m²	
PENRT	1.198,238 MJ/m²	**service life:** yes, integer
GWP100 total	120,390 kg CO_2/m²	**type:**
AP	0,322 kg SO_2/m²	new building

RC partition wall (staircase-hallway)

Wall: Partition wall between residential or office units

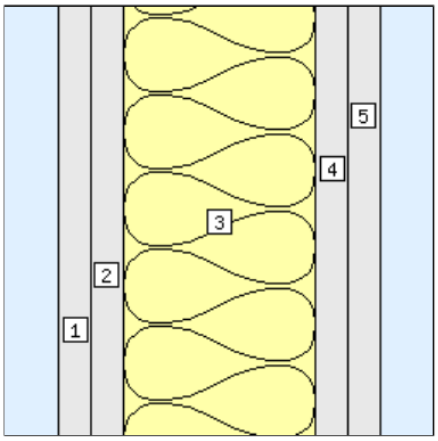


no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	[1]2
2		Reinforced concrete 80 kg/m³ reinforcing steel (1 vol.%)	40,000	2,300	0,174	[1]92
3		Normal plastering mortar GP lime cement (1600 kg/m³)	0,800	0,780	0,010	[1]2
		R_{si} / R_{se} =			0,130 / 0,130	
		R' / R" (max. relative error: 0,0%) =			0,454 / 0,454	
		building element	**41,600**		**0,454**	**95**

mass	**945,6 kg/m²**	
EI_{KON}	0,33 points/m²	
PENRT	1.083,552 MJ/m²	**service life:** yes, integer
GWP100 total	121,622 kg CO_2/m²	**type:**
AP	0,289 kg SO_2/m²	new building

p8 - Partition wall within apartment

Wall: within a residential and office unit not subject to a U-value requirement



no.	type	**layer** (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Knauf Gipskarton Bauplatte	1,250	0,250	0,050	2
2		Knauf Gipskarton Bauplatte	1,250	0,250	0,050	2
3		*inhomogeneous (parts horizontal)*	7,500			
		89,8 cm (100%) KI Trennwand-Dämmrolle TI 140 W	7,500	0,037	2,027	4
		0,2 cm (0%) Steel sheet, galvanised	7,500	50,000	0,002	4
4		Knauf Gipskarton Bauplatte	1,250	0,250	0,050	2
5		Knauf Gipskarton Bauplatte	1,250	0,250	0,050	2
		R_{si} / R_{se} =		0,130 / 0,130		
		R' / R'' (max. relative error: 43,6%) =		2,463 / 0,967		
		building element	**12,500**		**1,715**	**15**

U value:	**0,583 W/m²K**	
mass	**36,4 kg/m²**	
EI_{KON}	0,27 points/m²	
PENRT	212,577 MJ/m²	**service life:** yes, integer
GWP100 total	10,730 kg CO_2/m²	**type:**
AP	0,046 kg SO_2/m²	new building

solid and transparent building elements

area	building element	ΔOI3 BG5, ref. area	ΔOI3 per m²	PENRT kWh per m² GFA	GWP100 S kg CO_2 equ./ per m² GFA	AP kg SO_2 equ./ per m² GFA	EI_{KON} points per m²
883,10 m²	e3 - Green roof	11	160	42,70	10,22	0,0314	1,25
105,00 m²	e7 - Paved roof	1	157	5,04	1,24	0,0036	1,18
160,90 m²	e1* - Terrace (on green roof)	2	161	7,83	1,62	0,0061	1,08
214,10 m²	e2 - Terrace (on green roof)	2	148	9,77	1,89	0,0074	1,03
116,30 m²	e9 - Terrace (greening 10. floor)	1	153	5,29	1,30	0,0040	1,02
6.894,30 m²	a1 - Floors in apartments	64	119	218,65	63,12	0,2057	0,67
601,10 m²	a1* - Floors in apartments (10. floor)	6	131	20,77	6,19	0,0196	0,72
408,30 m²	a2 - Floors in apartments exposed to outside air	6	187	17,34	5,22	0,0227	1,33
808,80 m²	a3 - Floors in sanitary facilities	10	159	38,60	9,48	0,0287	0,73
63,10 m²	a3* - Floors in sanitary facilities (10. floor)	1	170	3,19	0,81	0,0024	0,78
180,00 m²	a4 - Floors in apartment above restaurant	3	179	7,85	2,12	0,0091	1,10
526,70 m²	a4 - Floors in apartment above unheated space	8	205	25,20	6,92	0,0318	1,34
34,70 m²	a5 - Floors in sanitary facilities above restaurant	1	202	1,90	0,49	0,0018	1,14
126,40 m²	a5 - Floors in sanitary facilities above unheated space	2	228	7,47	1,94	0,0077	1,38
571,10 m²	a6 - Floors in apartments (11. floor)	6	136	20,70	5,94	0,0194	0,82
59,90 m²	a7 - Floors in sanitary facilities (11. floor)	1	178	3,25	0,77	0,0024	0,97
1.095,10 m²	b1 - Floor in hallway	12	137	37,27	11,78	0,0394	0,64
100,00 m²	b1 - Floor in hallway (10. floor)	1	148	3,69	1,19	0,0039	0,69
77,20 m²	b1 - Floor in service area (Storey)	1	137	2,85	0,88	0,0025	0,66
222,40 m²	b10 - Floor in hallway (mezzanine)	3	177	8,63	2,84	0,0118	0,98
113,00 m²	b4 - Floor in staircase (landing)	1	92	2,58	0,78	0,0028	0,18
168,20 m²	b5 - Floor in staircase (stairs)	1	87	3,61	1,07	0,0040	0,16
56,20 m²	e4 - Loggia above heated area	1	174	3,03	0,67	0,0021	0,71
667,40 m²	Brick - External wall (loggia)	6	106	14,51	4,46	0,0228	0,80
688,10 m²	Installation shaft	4	81	15,41	2,61	0,0155	0,75
93,80 m²	installation shaft (Alu foil 12%)	1	196	5,00	0,99	0,0050	0,46
2.160,20 m²	p1 - Contact Facade	21	122	52,57	16,25	0,0873	0,96
642,90 m²	p2 - Ventilated Facade	5	107	14,85	3,80	0,0220	0,72
768,30 m²	p3a - External wall (staircase)	11	182	29,27	10,80	0,0422	1,14
330,70 m²	RC20 - External wall	4	139	9,07	3,23	0,0148	0,97
73,30 m²	RC20 - External wall (loggia)	1	123	1,82	0,65	0,0028	0,81
73,60 m²	RC30 - External wall	1	162	2,44	0,89	0,0037	1,07
18,89 m²	Glazed door Vz2	0	247	1,11	0,28	0,0014	
13,07 m²	Glazed door Vz3	0	258	0,80	0,20	0,0010	
3.152,38 m²	Window ESH 2	48	196	144,30	27,87	0,1966	
1.204,00 m²	p5 - Partition wall (apartment-hallway)	5	48	16,01	2,19	0,0170	0,43
3.328,10 m²	p6 - Partition wall (apartment-apartment)	15	57	51,20	7,50	0,0553	0,73
933,90 m²	RC partition wall (staircase-apartment)	8	103	24,28	8,78	0,0235	0,47
516,90 m²	RC partition wall (staircase-hallway)	4	95	12,15	4,91	0,0117	0,33
5.495,00 m²	p8 - Partition wall within apartment	6	15	25,35	4,61	0,0198	0,27
	sum			**917,34**	**238,51**	**1,0129**	**0,68**

5.1.2 Results for HVAC components - ESH

Results of eco2soft calculation for the HVAC components for ESH building:

HVAC hide references	ΔOI3 BG5, ref. area	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./
		per m² GFA		
HVAC single components	37	77,39	17,05	0,1841
70000 m Electric cable (PVC) NYM (YM) 3x1.5 mm²	4	9,55	1,43	0,0233
640 Stk. Steel tube radiator 4-column, radiators	2	6,47	1,60	0,0062
17500 m Copper pipe 15mmx1mm1	7	4,26	1,04	0,0465
4500 m Copper pipe 22mmx1mm1	3	1,61	0,40	0,0176
3800 m Copper pipe 35mmx1.5mm	5	3,28	0,80	0,0358
1100 m Steel pipe 5/4 inch DN 32	1	2,34	0,58	0,0029
128 Stk. Ventilation unit, decentralised, 180-250 m³/h	8	28,54	6,26	0,0298
200 m Spiral duct DN 125, steel	0	1,25	0,31	0,0019
250 m² Photovoltaic panel, a-Si	6	20,08	4,63	0,0201
sum		**77,39**	**17,05**	**0,1841**

5.1.3 Results for disposal - ESH

Results of eco2soft calculation for disposal indicators for ESH building. Disposal indicators for HVAC components and some of fastening material are currently not available in eco2soft tool:

disposal	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./
	per m² GFA		
sum (100,0% of all components with known mass included)	**100,10**	**66,08**	**0,1164**

The following components could not be included in the calculation: *Dübel kompl. 38cm, Dübel kompl. 8cm, Electric cable (PVC) NYM (YM) 3x1.5 mm², Steel tube radiator 4-column, radiators, Copper pipe 15mmx1mm1, Copper pipe 22mmx1mm1, Copper pipe 35mmx1.5mm, Steel pipe 5/4 inch DN 32, Ventilation unit, decentralised, 180-250 m³/h, Spiral duct DN 125, steel, Photovoltaic panel, a-Si.* They are not included in the disposal

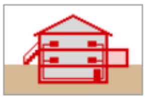
5.1.4 Results for operation - ESH

Results of eco2soft calculation for the operational phase for ESH building:

operation energy based on 10.867 m² hide individual energy sources	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./
	per m² GFA		
hot water (16 kWh/m²a)	278,39	66,58	0,0831
Fernwärme mit KWK (100 % Gas) (16 kWh/m²a)	278,39	66,58	0,0831
space heating (19 kWh/m²a)	377,93	91,92	0,1241
Fernwärme mit KWK (100 % Gas) (18 kWh/m²a)	313,19	74,90	0,0935
Power (consumption mix Austria) (1 kWh/m²a)	64,74	17,02	0,0306
operating current (0 kWh/m²a)	0,00	0,00	0,0000
sum (final energy requirement) (35 kWh/m²a)	**656,32**	**158,50**	**0,2072**

5.1.5 Overall result for ESH building

Results for overall building LCA assessment for ESH building:

		OI3	PENRT	GWP100 S	AP	EI
			kWh	kg CO_2 equ./	kg SO_2 equ./	points
	**building overall**	BG5, ref. area	per m² GFA			per m²
		322	1.751,14	480,15	1,5206	0,68

5.2 RESULTS OF LCA FOR Reference building

5.2.1 Results for solid and transparent building elements

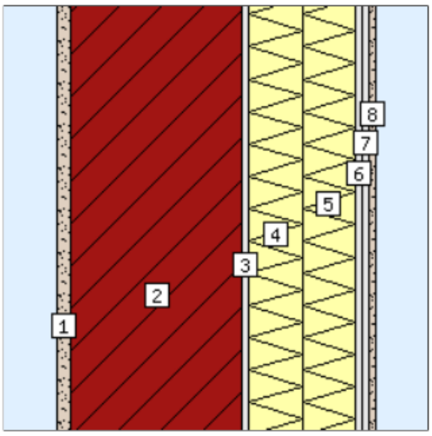
Results and graphic details of solid and transparent building elements calculated with eco2soft for ESH building are presented below. All structures of thermal building envelope, all intermediate floors and partition walls have been included in building model, with the same material properties and the same surface area as for ESH building.

As mentioned before, there are some differences between ESH building and Reference building. The thermal envelope of the building and buildings HVAC systems were altered in a way that the building meets the minimum requirement for energy efficiency according to national legislation (PURES 2015). Two of the main facades have less thermal insulation, triple glazed glass was changed to double glazed and there is no heat recovery and in Reference building.

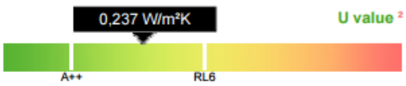
Only results for structural components that were changed in relation to ESH building and overall result of LCA will be listed here.

p1 - Contact Facade PURES

Wall: exposed to outside air – not back-ventilated



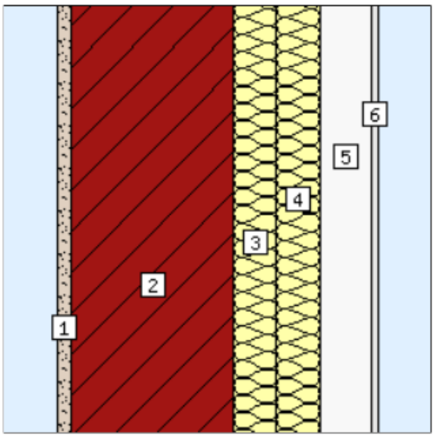
no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Vertically perforated brick 17 cm to 38 cm + normal mort	19,000	0,280	0,679	29
3		Mineral adhesive	0,300	1,000	0,003	2
4		KI Putzträgerplatte FKD-S C1	6,000	0,036	1,667	25
5		KI Putzträgerplatte FKD-S C1	6,000	0,036	1,667	25
6		Glass-fibre reinforcement	0,010	0,200	0,001	0
7		Mineral adhesive	0,600	1,000	0,006	3
8		Silicate plaster (without synthetic resin additive)	0,200	0,800	0,003	1
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				2
		R_{si} / R_{se} =			0,130 / 0,040	
		R' / R" (max. relative error: 0,0%) =			4,213 / 4,213	
		building element	**33,610**		**4,213**	**90**



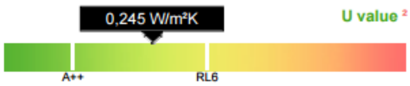
mass	**227,0 kg/m²**	
EI_{KON}	0,64 points/m²	
PENRT	882,142 MJ/m²	**service life:** yes, integer
GWP100 total	74,644 kg CO_2/m²	**type:** new building
AP	0,359 kg SO_2/m²	

p2 - Ventilated Facade PURES

Wall: exposed to outside air – back-ventilated



no.	type	layer (from inside to outside)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Normal plastering mortar GP lime cement (1600 kg/m³)	1,500	0,780	0,019	3
2		Vertically perforated brick 17 cm to 38 cm + normal mort	19,000	0,280	0,679	29
3		KI Fassaden-Dämmplatte TP 435 B	5,000	0,034	1,471	5
4		KI Fassaden-Dämmplatte TP 435 B	5,000	0,034	1,471	5
5		Vertical air layer, horizontal heat flow 55 < d <= 60 mm	6,000	0,333	0,180	[1]0
6		RHEINZINK-Fassaden	0,100	[3]	[3]	[1]35
additional materials (thermally not relevant): (quantity per m² building element)						
		6 pComplete dowel 38 cm				[1]2
		1,5 kgSteel anchors				[1]17
		R_{si} / R_{se} =			0,130 / 0,130	
		R' / R" (max. relative error: 0,0%) =			4,079 / 4,079	
		building element	**36,600**		**4,079**	**97**



mass	**201,5 kg/m²**	
EI_{KON}	0,42 points/m²	
PENRT	948,511 MJ/m²	**service life:** yes, integer
GWP100 total	69,528 kg CO_2/m²	**type:** new building
AP	0,401 kg SO_2/m²	

building element without title

Window (transparent element): Window or glass doors, glazed doors or other vertical transparent structural element respectively in residential buildings (RB) exposed to outside air, 1 wing

service life: yes, integer
Art: new building

U_w:[1]	width x height:	ΔOI3:	PENRT:	GWP100 S:	AP:
1,211 W/m²K	1,4 x 2,3 m	160 pts/m²	1.808,27 MJ/m²	91,5524 kg CO_2 equ./m²	0,636077 kg SO_2 equ./m²

component	title	indicator(s)	ΔOI3
glazing	Double-glazed heat-protection glass, Argon, pane thickness >= 24 mm	U_g = 1,150 W/m²K	55
window frame	Highly heat-insulating aluminium frame	U_f = 1,100 W/m²K frame width = 0,15 m	105
ψ (linear heat transfer coefficient)	reference (Plastic/butyl (2-IV; Ug <1.4; Uf <1.4))	ψ = 0,040 W/mK	

area	building element	ΔOI3 BG5, ref. area	ΔOI3 per m²	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./	EI_{KON} points per m²
	solid and transparent building elements			per m² GFA	per m² GFA	per m² GFA	
883,10 m²	e3 - Green roof	11	160	42,70	10,22	0,0314	1,25
105,00 m²	e7 - Paved roof	1	157	5,04	1,24	0,0036	1,18
160,90 m²	e1* - Terrace (on green roof)	2	161	7,83	1,62	0,0061	1,08
214,10 m²	e2 - Terrace (on green roof)	2	148	9,77	1,89	0,0074	1,03
116,30 m²	e9 - Terrace (greening 10. floor)	1	153	5,29	1,30	0,0040	1,02
6.894,30 m²	a1 - Floors in apartments	64	119	218,65	63,12	0,2057	0,67
601,10 m²	a1* - Floors in apartments (10. floor)	6	131	20,77	6,19	0,0196	0,72
408,30 m²	a2 - Floors in apartments exposed to outside air	6	187	17,34	5,22	0,0227	1,33
808,80 m²	a3 - Floors in sanitary facilities	10	159	38,60	9,48	0,0287	0,73
63,10 m²	a3* - Floors in sanitary facilities (10. floor)	1	170	3,19	0,81	0,0024	0,78
180,00 m²	a4 - Floors in apartment above restaurant	3	179	7,85	2,12	0,0091	1,10
526,70 m²	a4 - Floors in apartment above unheated space	8	205	25,20	6,92	0,0318	1,34
34,70 m²	a5 - Floors in sanitary facilities above restaurant	1	202	1,90	0,49	0,0018	1,14
126,40 m²	a5 - Floors in sanitary facilities above unheated space	2	228	7,47	1,94	0,0077	1,38
571,10 m²	a6 - Floors in apartments (11. floor)	6	136	20,70	5,94	0,0194	0,82
59,90 m²	a7 - Floors in sanitary facilities (11. floor)	1	178	3,25	0,77	0,0024	0,97
1.095,10 m²	b1 - Floor in hallway	12	137	37,27	11,78	0,0394	0,64
100,00 m²	b1 - Floor in hallway (10. floor)	1	148	3,69	1,19	0,0039	0,69
77,20 m²	b1 - Floor in service area (Storey)	1	137	2,85	0,88	0,0025	0,66
222,40 m²	b10 - Floor in hallway (mezzanine)	3	177	8,63	2,84	0,0118	0,98
113,00 m²	b4 - Floor in staircase (landing)	1	92	2,58	0,78	0,0028	0,18
168,20 m²	b5 - Floor in staircase (stairs)	1	87	3,61	1,07	0,0040	0,16
56,20 m²	e4 - Loggia above heated area	1	174	3,03	0,67	0,0021	0,71
667,40 m²	Brick - External wall (loggia)	6	106	14,51	4,46	0,0228	0,80
688,10 m²	Installation shaft	4	81	15,41	2,61	0,0155	0,75
93,80 m²	installation shaft (Alu foil 12%)	1	196	5,00	0,99	0,0050	0,46
2.160,20 m²	p1 - Contact Facade PURES	15	90	41,35	12,60	0,0606	0,64
642,90 m²	p2 - Ventilated Facade PURES	5	97	13,23	3,49	0,0201	0,42
768,30 m²	p3a - External wall (staircase)	11	182	29,27	10,80	0,0422	1,14
330,70 m²	RC20 - External wall	4	139	9,07	3,23	0,0148	0,97
73,30 m²	RC20 - External wall (loggia)	1	123	1,82	0,65	0,0028	0,81
73,60 m²	RC30 - External wall	1	162	2,44	0,89	0,0037	1,07
18,89 m²	Glazed door Vz2	0	247	1,11	0,28	0,0014	
13,07 m²	Glazed door Vz3	0	258	0,80	0,20	0,0010	
3.152,38 m²	Window ESH 2 PURES	39	160	123,71	22,55	0,1567	
1.204,00 m²	p5 - Partition wall (apartment-hallway)	5	48	16,01	2,19	0,0170	0,43
3.328,10 m²	p6 - Partition wall (apartment-apartment)	15	57	51,20	7,50	0,0553	0,73
933,90 m²	RC partition wall (staircase-apartment)	8	103	24,28	8,78	0,0235	0,47
516,90 m²	RC partition wall (staircase-hallway)	4	95	12,15	4,91	0,0117	0,33
5.495,00 m²	p8 - Partition wall within apartment	6	15	25,35	4,61	0,0198	0,27
	sum			**883,92**	**229,23**	**0,9444**	**0,65**

5.2.2 Results for HVAC components – Reference building

Results of eco2soft calculation for the HVAC components for Reference building. To meet the minimum requirements of energy efficiency according to PURES, ventilation system with heat recovery was into taken into account here:

HVAC hide references	ΔOI3 BG5, ref. area	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./
		per m² GFA	per m² GFA	per m² GFA
HVAC single components	22	27,52	5,85	0,1323
70000 m Electric cable (PVC) NYM (YM) 3x1.5 mm²	4	9,55	1,43	0,0233
640 Stk. Steel tube radiator 4-column, radiators	2	6,47	1,60	0,0062
17500 m Copper pipe 15mmx1mm1	7	4,26	1,04	0,0465
4500 m Copper pipe 22mmx1mm1	3	1,61	0,40	0,0176
3800 m Copper pipe 35mmx1.5mm	5	3,28	0,80	0,0358
1100 m Steel pipe 5/4 inch DN 32	1	2,34	0,58	0,0029
sum		**27,52**	**5,85**	**0,1323**

5.2.3 Results for disposal – Reference building

Results of eco2soft calculation for disposal indicators for Reference building. Disposal indicators for HVAC components and some of fastening material are currently not available in eco2soft tool:

disposal	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./
	per m² GFA		
sum (100,0% of all components with known mass included)	**99,94**	**66,05**	**0,1162**

The following components could not be included in the calculation: *Dübel kompl. 38cm, Dübel kompl. 8cm, Electric cable (PVC) NYM (YM) 3x1.5 mm², Steel tube radiator 4-column, radiators, Copper pipe 15mmx1mm1, Copper pipe 22mmx1mm1, Copper pipe 35mmx1.5mm, Steel pipe 5/4 inch DN 32.* They are not included in the disposal

5.2.4 Results for operation – Reference building

Results of eco2soft calculation for the operational phase for Reference building

operation
energy based on 10.867 m²
show individual energy sources

	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./
	per m² GFA		
hot water (16 kWh/m²a)	278,39	66,58	0,0831
space heating (40 kWh/m²a)	743,32	179,31	0,2332
operating current (0 kWh/m²a)	0,00	0,00	0,0000
sum (final energy requirement) (56 kWh/m²a)	**1.021,70**	**245,89**	**0,3163**

5.2.5 Overall result for Reference building

Results for overall building LCA assessment for Reference building

building overall	OI3	PENRT kWh	GWP100 S kg CO_2 equ./	AP kg SO_2 equ./	EI points
	BG5, ref. area	per m² GFA			per m²
	292	2.033,08	547,02	1,5092	0,65

5.3 COMPARISON OF RESULTS AND INPUT DATA FOR ENERGY CONSUMPTION BETWEN ESH building AND Reference building.

5.3.1 Comparison of results of eco2sof analyses

Results of eco2sof analyses between both building models are elaborated in table below separately for different building components. Differences are marked in blue.

Table 1: Comparison of ΔOI3 of building solid and transparent building elements

Solid and transparent building elements	Area	ESH building		Reference building	
	(m²)	ΔOI3 BG5, ref. area	ΔOI3 (per m²)	ΔOI3 BG5, ref. area	ΔOI3 (per m²)
e3 - Green roof	883	11	160	11	160
e7 - Paved roof	105	1	157	1	157
e1* - Terrace (on green roof)	161	2	161	2	161
e2 - Terrace (on green roof)	214	2	148	2	148
e9 - Terrace (greening 10. floor)	116	1	153	1	153
a1 - Floors in apartments	6.894	64	119	64	119
a1* - Floors in apartments (10. floor)	601	6	131	6	131
a2 - Floors in apartments exposed to outside air	408	6	187	6	187
a3 - Floors in sanitary facilities	809	10	159	10	159
a3* - Floors in sanitary facilities (10. floor)	63	1	170	1	170
a4 - Floors in apartment above restaurant	180	3	179	3	179
a4 - Floors in apartment above unheated space	527	8	205	8	205
a5 - Floors in sanitary facilities above restaurant	35	1	202	1	202
a5 - Floors in sanitary facilities above unheated space	126	2	228	2	228
a6 - Floors in apartments (11. floor)	571	6	136	6	136
a7 - Floors in sanitary facilities (11. floor)	60	1	178	1	178
b1 - Floor in hallway	1.095	12	137	12	137
b1 - Floor in hallway (10. floor)	100	1	148	1	148
b1 - Floor in service area (Storey)	77	1	137	1	137
b10 - Floor in hallway (mezzanine)	222	3	177	3	177
b4 - Floor in staircase (landing)	113	1	92	1	92
b5 - Floor in staircase (stairs)	168	1	87	1	87
e4 - Loggia above heated area	56	1	174	1	174
Brick - External wall (loggia)	667	6	106	6	106
Installation shaft	688	4	81	4	81
installation shaft (Alu foil 12%)	94	1	196	1	196
p1 - Contact Facade	2.160	21	122	15	90

p2 - Ventilated Facade	643	5	107	5	97
p3a - External wall (staircase)	768	11	182	11	182
RC20 - External wall	331	4	139	4	139
RC20 - External wall (loggia)	73	1	123	1	123
RC30 - External wall	74	1	162	1	162
Glazed door Vz2	19	0	247	0	247
Glazed door Vz3	13	0	258	0	258
Window ESH 2	3.152	48	196	39	160
p5 - Partition wall (apartment-hallway)	1.204	5	48	5	48
p6 - Partition wall (apartment-apartment)	3.328	15	57	15	57
RC partition wall (staircase-apartment)	934	8	103	8	103
RC partition wall (staircase-hallway)	517	4	95	4	95
p8 - Partition wall within apartment	5.495	6	15	6	15

Results for ΔOI3 index of solid and transparent building components show that the reference building has the lower ΔOI3 index for those construction components; where less thermal insulation material was used in order to meet the minimum requirements for energy efficiency in buildings according to national legislation PURES 2010.

Table 2: Comparison of ΔOI3 for HVAC components

HVAC		**ESH building**	**Reference building**
		ΔOI3 BG6,ref. area	**ΔOI3 BG6, ref. area**
Electric cable (PVC) NYM (YM) 3x1.5 mm²	70000 m	4	4
Steel tube radiator 4-column, radiators	640 Stk.	2	2
Copper pipe 15mmx1mm1	17500 m	7	7
Copper pipe 22mmx1mm1	4500 m	3	3
Copper pipe 35mmx1.5mm	3800 m	5	5
Steel pipe 5/4 inch DN 32	1100 m	1	1
Ventilation unit, decentralised, 180-250 m³/h	128 Stk.	8	No ventilation units
Spiral duct DN 125, steel	200 m	0	No ventilation ducts
Photovoltaic panel	250 m²	6	No Photovoltaic panel

In order to meet the minimum requirements of PURES 2015 in reference scenario, mechanical ventilation with heat recovery was not included in LCA analyses. Reference building therefore has no ventilation units in apartments, spiral ducts connecting ventilation unit to main shaft. Reference building is also without micro solar power plant. ΔOI3 index for HVAC components is therefore better in reference scenario.

Table 3: Comparison of environmental indicators for overall building assessment for the 50-year assessment period

Building overall	**ΔOI3**	**PENRT**	**GWP100 S**	**AP**	**EI (disposal**
	BG5, ref. area	**(kWh/per m² GFA)**	**(kg CO_2 equ./per m² GFA)**	**(kg SO_2 equ./per m² GFA)**	**points per m²**
ESH building	322	1.751,14	480,15	1,5206	0,68
Reference building	292	2.033,08	547,02	1,5092	0,65

Difference between both building models are clear. ESH building model based on actual characteristics of constructed building shows better performance in total non-renewable primary energy resources required by ESH building in 50-year assessment period. The same relation towards the Reference building is for Global warming potential indicator. Better performance for both indicators is due to significantly lower energy consumption of ESH building in relation to Reference building.

However, Reference building on the other hand shows better performance in overall ΔOI3 index for building components, and Acidification potential indicator. Results indicates, that the production of extra material needed for thermal insulation, production of triple glazed glazing, all extra HVAC components and micro solar power plant, does not return through the lower energy consumption, when district heating is used as energy resource.

Reference building also shows better performance for disposal indicator. This result was expected, since there are the same building material characteristic and disposal options selected for both building models. Les material therefore equals les disposal.

5.3.2 Comparison of energy demand between ESH building and Reference building

Energy demand for both building models was calculated according to PHPP methodology. Same building thermal envelope characteristics and HVAC components were used for energy and LCA calculations.

Table 4: Comparison of energy demand for both building models.

Structure of energy demand		ESH building	Reference building	Enery source
Ref. area for energy demand for according to PHPP	($m^{2)}$	10.867,00	10.867,00	
Final energy demand - domestic hot water preparation	(kWh/m^2a)	16,60	16,60	District heating
Final energy demand - space heating	(kWh/m^2a)	18,40	39,30	District heating
Final Energy Demand for - Ventilation	(kWh/a)	34.697,00	0,00	Electricity
Final Energy Demand for - Lighting	(kWh/a)	9.904,49	9.904,49	Electricity
Final Auxiliary Energy Demand	(kWh/a)	8.814,00	8.814,00	Electricity
Micro solar power plant (calculated yearly production)	(kWh/a)	34.300,00	0,00	Electricity
Overall electricity demand	(kWh/a)	19.115,49	18.718,49	Electricity
Overall electricity demand based on ref. area	(kWh/m^2a)	1,76	1,72	Electricity

Results show, that the energy demand for space heating in ESH building is significantly lower, because better thermal envelope characteristics and mechanical ventilation with heat recovery.

Total electricity consumption of ESH building is composed from electricity demand for mechanical ventilation, lighting and auxiliary energy for HVAC systems. Overall electricity demand of ESH building is for the purpose of LCA assessment lowered for the amount of annual electricity produced on site, from the micro solar power plant located on the roof of the building. The amount of overall electricity demand of is in range with overall electricity demand of Reference building, since the reference scenario does not include mechanical ventilation. No reduction for electricity demand due to micro solar power plant is made for reference scenario.

6. DESCRIPTION OF SUSTAINABILITY ASSESSEMENT FOR ECO SILVER HOUSE - ESH

Considered indicators and sustainability evaluation methodology of individual indicators is described in more detail in this chapter. Indicator assessment closely follows the OPEN HOUSE methodology for sustainability assessment, with possible adaptation to national building codes, and local environment.

6.1 ENVIRONMENTAL QUALITY INDICATORS

The environmental indicators considered and evaluated within OPEN HOUSE methodology are:

- **Global Warming Potential (GWP)**
- **Ozone Depletion Potential (ODP)**
- **Acidification Potential (AP)**
- **Eutrophication Potential (EP)**
- **Photochemical Ozone Creation Potential (POCP)**
- Biodiversity and Depletion of Habitats
- Light Pollution
- **Abiotic depletion of non-renewable fossil fuels due to non-renewable Primary Energy Demand (ADP_Enr)**
- **Total Primary Energy Demand and Percentage of Renewable Primary Energy**
- **Water and Waste Water**
- **Land use**
- **Waste**
- Energy efficiency of building equipment (lifts, escalators and moving walks)
- **Contribution to the depletion of abiotic resources - non fossil fuels (ADPelement)**

Core indicators are in bold. Evaluation procedures are described in document below.

6.1.1 EVALUATION OF EVIRONMENTAL QUALITY INDICATORS

6.1.1.1 Global Warming Potential (GWP)

Global warming potential was evaluated proportional to Reference building. Evaluation scale factors for maximum (100 points) and minimum (0 points) are set according to OPEN HOUSE methodology. GWP Indicator was calculated with eco2soft program for ESH and Reference building. 70.37 points were awarded to ESH for this indicator.

Results for GWP for Reference building serves as a reference number with GWP indicator worth 50 points. Limit value for GWP indicator worth 100 points is obtained by multiplying GWP for Reference building with scale factor of 0,7. The same is done for the lower limit worth 0 points, by multiplying GWP for Reference building with scale factor of 1,4.

Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- GWP_{LCref} – Result of eco2soft calculation for Reference building
- **$GWP_{LC,ESH}$** – Result of eco2soft calculation for ESH building

Table 5: Evaluation of GWP indicator

Global Warming Potential		
Scale factor	**(GWP100 S kg CO2 equ./per m² GFA)**	**Points**
0,70	382,91	100
0,76	415,74	90
0,82	448,56	80
0,88	481,38	70
0,94	514,20	60
1	**547,02**	**50**
1,1	601,72	40
1,2	656,42	30
1,3	711,13	20
1,40	765,83	10
x>1,4	Minimum requirements not fulfilled	0
GWP_{LCref}	547,02	50
$GWP_{LC,ESH}$	**480,15**	**70,37**

6.1.1.2 Ozone Depletion Potential (ODP)

Ozone depletion potential was evaluated proportional to Reference building. Evaluation scale factors for maximum (100 points) and minimum (0 points) are set according to OPEN HOUSE methodology. ODP indicator was calculated with eco2soft program for ESH and Reference building. 54,61 points were awarded to ESH for this indicator.

Results for ODP for Reference building serves as a reference number with ODP indicator worth 50 points. Limit value for ODP indicator worth 100 points is obtained by multiplying ODP for Reference building with scale factor of 0,7. The same is done for the lower limit worth 0 points, by multiplying ODP for Reference building with scale factor of 10.

Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- ODP_{LCref} – Result of eco2soft calculation for Reference building
- **$ODP_{LC,ESH}$** – Result of eco2soft calculation for ESH building

Table 6: Evaluation of ODP indicator

Ozone Depletion Potential		
Scale factor	**(kg CFC-11 equiv./(m²GFA))**	**Points**
0,70	0,0000023806	100
0,76	0,0000025847	90
0,82	0,0000027887	80
0,85	0,0000028908	75
0,88	0,0000029928	70
0,94	0,0000031969	60
1	**0,0000034009**	**50**
3,25	0,0000110530	40
5,5	0,0000187050	30
7,75	0,0000263571	20
10,00	0,0000340091	10
x>10	Minimum requirements not fulfilled	0
ODP_{LCref}	0,000003401	50
$ODP_{LC,ESH}$	**0,000003307**	**54,61**

6.1.1.3 Acidification Potential (AP)

Acidification potential was evaluated proportional to Reference building. Evaluation scale factors for maximum (100 points) and minimum (0 points) is are according to OPEN HOUSE methodology. AP indicator was calculated with eco2soft program for ESH and Reference building. 49,57 points were awarded to ESH for this indicator.

Results for AP for Reference building serves as a reference number with AP indicator worth 50 points. Limit value for AP indicator worth 100 points is obtained by multiplying AP for Reference building with scale factor of 0,7. The same is done for the lower limit worth 0 points, by multiplying AP for Reference building with scale factor of 1,7.

Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- AP_{LCref} – Result of eco2soft calculation for Reference building
- **$AP_{LC,ESH}$** – Result of eco2soft calculation for ESH building

Table 7: Evaluation of AP indicator

Acidification Potential		
Scale factor	**(AP kg SO2 equ./per m² GFA)**	**Points**
0,7	1,0564	100
0,76	1,1470	90
0,82	1,2375	80
0,85	1,2828	75
0,88	1,3281	70
0,94	1,4186	60
1	**1,5092**	**50**
1,175	1,7733	40
1,35	2,0374	30
1,525	2,3015	20
1,7	2,5656	10
x>1,7	Minimum requirements not fulfilled	0
AP_{LCref}	1,5092	50
$AP_{LC,ESH}$	**1,5206**	**49,57**

6.1.1.4 Eutrophication Potential (EP)

Eutrophication potential was evaluated proportional to Reference building. Evaluation scale factors for maximum (100 points) and minimum (0 points) is are according to OPEN HOUSE methodology. EP indicator was calculated with eco2soft program for ESH and Reference building. 49,7 points were awarded to ESH for this indicator.

Results for EP for Reference building serves as a reference number with EP indicator worth 50 points. Limit value for EP indicator worth 100 points is obtained by multiplying EP for Reference building with scale factor of 0,7. The same is done for the lower limit worth 0 points, by multiplying EP for Reference building with scale factor of 1,7.

Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- EP_{LCref} – Result of eco2soft calculation for Reference building
- **$EP_{LC,ESH}$** – Result of eco2soft calculation for ESH building

Table 8: Evaluation of EP

Eutrophication Potential		
Scale factor	**(kg PO4 equiv./(m²GFA)**	**Points**
0,70	0,062	100
0,76	0,067	90
0,82	0,072	80
0,85	0,075	75
0,88	0,078	70
0,94	0,083	60
1	**0,088**	**50**
1,175	0,104	40
1,35	0,119	30
1,525	0,135	20
1,70	0,150	10
x>1,7	Minimum requirements not fulfilled	0
EP_{LCref}	0,088	50
$EP_{LC,ESH}$	**0,089**	**49,70**

6.1.1.5 Photochemical Ozone Creation Potential (POCP)

Photochemical ozone creation potential was evaluated proportional to Reference building. Evaluation scale factors for maximum (100 points) and minimum (0 points) are set according to OPEN HOUSE methodology. POCP indicator was calculated with eco2soft program for ESH and Reference building. 48,99 points were awarded to ESH for this indicator.

Results for POCP for Reference building serves as a reference number with POCP indicator worth 50 points. Limit value for POCP indicator worth 100 points is obtained by multiplying POCP for Reference building with scale factor of 0,7. The same is done for the lower limit worth 0 points, by multiplying POCP for Reference building with scale factor of 1,7.

Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- $POCP_{LCref}$ – Result of eco2soft calculation for Reference building
- **$POCP_{LC,ESH}$** – Result of eco2soft calculation for ESH building

Table 9: Evaluation of POCP

Photochemical Ozone Creation Potential		
Scale factor	**(kg C2H4 equiv./(m²GFA *a)**	**Points**
0,70	0,0229	100
0,76	0,0248	90
0,82	0,0268	80
0,85	0,0278	75
0,88	0,0288	70
0,94	0,0307	60
1	**0,0327**	**50**
1,175	0,0384	40
1,35	0,0441	30
1,525	0,0499	20
1,70	0,0556	10
x>1,7	Minimum requirements not fulfilled	0
$POCP_{LCref}$	0,0327	50
$POCP_{LC,ESH}$	**0,0333**	**48,99**

6.1.1.6 Biodiversity and Depletion of Habitats

Biodiversity and Depletion of Habitats is evaluated through the change in ecological value of the site. This sub-indicator assesses the ecological characteristics of the site immediately prior to and after the development of the case-study building.

Change in ecological value is calculated with the comparison of plant species on the site pre and post construction.

Ecological value of the existing site was evaluated as hard landscaping with 0 species.

Ecological value of the proposed site vas evaluated as building with 0 species.

Therefore the change in ecological value if the site is 0.

Table 10: Evaluation of ecological value of the building site

Change in ecological value of the site: enhancement of biodiversity	
Scale	**Points**
Requirements are satisfied and Change in ecological value ≥ 6	100
Requirements are satisfied and 5 ≤ Change in ecological value < 6	90
Requirements are satisfied and 4 ≤ Change in ecological value < 5	80
Requirements are satisfied and 3 ≤ Change in ecological value < 4	70
Requirements are satisfied and 2 ≤ Change in ecological value < 3	60
Requirements are satisfied and 1 ≤ Change in ecological value < 2	50
Requirements are satisfied and 0 ≤ Change in ecological value < 1	40
Requirements are satisfied and -2 ≤ Change in ecological value < 0	30
Requirements are satisfied and -3 ≤ Change in ecological value < -2	20
Requirements are satisfied and -9 ≤ Change in ecological value < -3	10
Requirements are not satisfied	0
Indicator evaluation for ESH	**40**

6.1.1.7 Light Pollution

The indicator assess the quality of public lighting on the premises. Public lighting of ESH building is according to standards. The quality of public lighting is evaluated with four main characteristics:

- Light on properties
- Luminaire intensity
- Upward light
- Luminance

6.1.1.7a Light on properties

Table 11: Evaluation of light on properties

Light on properties	
Scale	**Points**
The maximum value of vertical illuminance on properties is lower than the EN 12464-2 value for the classified zone	100
The maximum value of vertical illuminance on properties is higher than the EN 12464-2 value for the classified zone	0
Indicator evaluation for ESH	**100**

6.1.1.7b Luminaire intensity

Table 12: Evaluation of luminaire intensity

Luminaire intensity	
Scale	**Points**
The maximum value of the light intensity of each source in the potentially obtrusive direction is lower than the EN 12464-2 value for the classified zone	100
The maximum value of the light intensity of each source in the potentially obtrusive direction is higher than the EN 12464-2 value for the classified zone	0
Indicator evaluation for ESH	**100**

6.1.1.7c Upward light

Table 13: Evaluation of upward light

Upward light	
Scale	**Points**
The upward light values are lower than the requirements from EN 12464-2 for the classified zone	100
The upward light values are higher than the requirements from EN 12464-2 for the classified zone	0
Indicator evaluation for ESH	**100**

6.1.1.7d Luminance

Table 14: Evaluation of luminance

Luminance	
Scale	**Points**
The maximum average luminance of the signs and of the facade of a building is lower than the EN 12464-2 values for the classified zone	100
The maximum average luminance of the signs and of the facade of a building is higher than the EN 12464-2 values for the classified zone	0
Indicator evaluation for ESH	**100**

6.1.1.8 Abiotic depletion of non-renewable fossil fuels due to non-renewable Primary Energy Demand (ADP_Enr)

Photochemical ozone creation potential was evaluated proportional to Reference building. Evaluation scale factors for maximum (100 points) and minimum (0 points) are set according to OPEN HOUSE methodology. PEnr indicator was calculated with eco2soft program for ESH and Reference building. F3,11 points were awarded to ESH for this indicator.

Results for PEnr for Reference building serves as a reference number with PEnr indicator worth 50 points. Limit value for PEnr indicator worth 100 points is obtained by multiplying PEnr for Reference building with scale factor of 0,7. The same is done for the lower limit worth 0 points, by multiplying PEnr for Reference building with scale factor of 1,4. Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- $PEnr_{LCref}$ – Result of eco2soft calculation for Reference building
- **$PEnr_{LC,ESH}$** – Result of eco2soft calculation for ESH building

Table 15: Evaluation of ADP_Enr

Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_Enr)		
Scale factor	**(kWh/per m² GFA)**	**Points**
0,7	1.423,16	100
0,76	1.545,14	90
0,82	1.667,13	80
0,88	1.789,11	70
0,94	1.911,10	60
1	**2.033,08**	**50**
1,1	2.236,39	40
1,2	2.439,70	30
1,3	2.643,00	20
1,4	2.846,31	10
x>1,4	Minimum requirements not fulfilled	0
$PEnr_{LCref}$	2.033,08	50
$PEnr_{LC,ESH}$	**1.751,14**	**73,11**

6.1.1.9 Total Primary Energy Demand and Share of Renewable Primary Energy

This indicator is composed of two sub indicators evaluating total primary energy demand and the share of renewable energy.

Picture 4: Micro solar power plant ESH

6.1.1.9a Total Primary Energy Demand

Evaluation of total primary energy demand was evaluated proportional to reference building scenario. Only the primary energy demand for building operation is taken into account in this indicator. Primary energy demand was calculated according to PHPP methodology for ESH and Reference building.

Evaluation scale for maximum (100 points) and minimum (0 points) is set according to OPEN HOUSE methodology. Results for PE for Reference building serves as a reference number with PE indicator worth 25 points. Limit value for PE indicator worth 100 points is obtained by multiplying PE for Reference building with scale factor of 0,4. The same is done for the lower limit worth 0 points, by multiplying PE for Reference building with scale factor of 1,4

Amount of points awarded to ESH building is obtained by linear interpolation between indicator result for Reference building and value on the upper or lower limit, depending if result of ESH building is better or worse than Reference building.

- PE_{LCref} – Total primary energy demand of Reference building (PHPP)
- **$PE_{LC,ESH}$** – Total primary energy demand of ESH building (PHPP)

Table 16: Evaluation of total PE demand

Total Primary Energy Demand		
Scale	**(kWh/m²a)**	**Points**
0,4	47,20	100
0,43	50,74	95
0,46	54,28	90
0,49	57,82	85
0,52	61,36	80
0,55	64,90	75
0,58	68,44	70
0,61	71,98	65
0,64	75,52	60
0,67	79,06	55
0,7	82,60	50
0,78	92,04	45
0,82	96,76	40
0,88	103,84	35
0,94	110,92	30
1	**118,00**	**25**
1,1	129,80	20
1,2	141,60	15
1,3	153,40	10
1,4	165,20	5
x>1,4	Minimum requirements not fulfilled	0
PE_{LCref}	118,00	25
$PE_{LC,ESH}$	**106,00**	**37,71**

6.1.1.9b Share of renewable Primary Energy in Total Primary Energy Demand

Share of renewable energy is calculated as a share of electricity produced from micro solar power plant in total primary energy demand of ESH calculated according to PHPP methodology.

Yearly calculated electricity production of micro solar power plant is 34.300 kWh. Electricity production of micro solar power plant presents 6 kWh/m2a of specific primary energy reduction through solar electricity. Total primary energy demand of ESH according to PHPP is 106 kWh/m2a. Share of renewable primary energy is therefore 6% and that awards total of 15 points to ESH.

The evaluation of indicator is qualitative nature. Points are given in relation to the extent of which the building meets desired criteria.

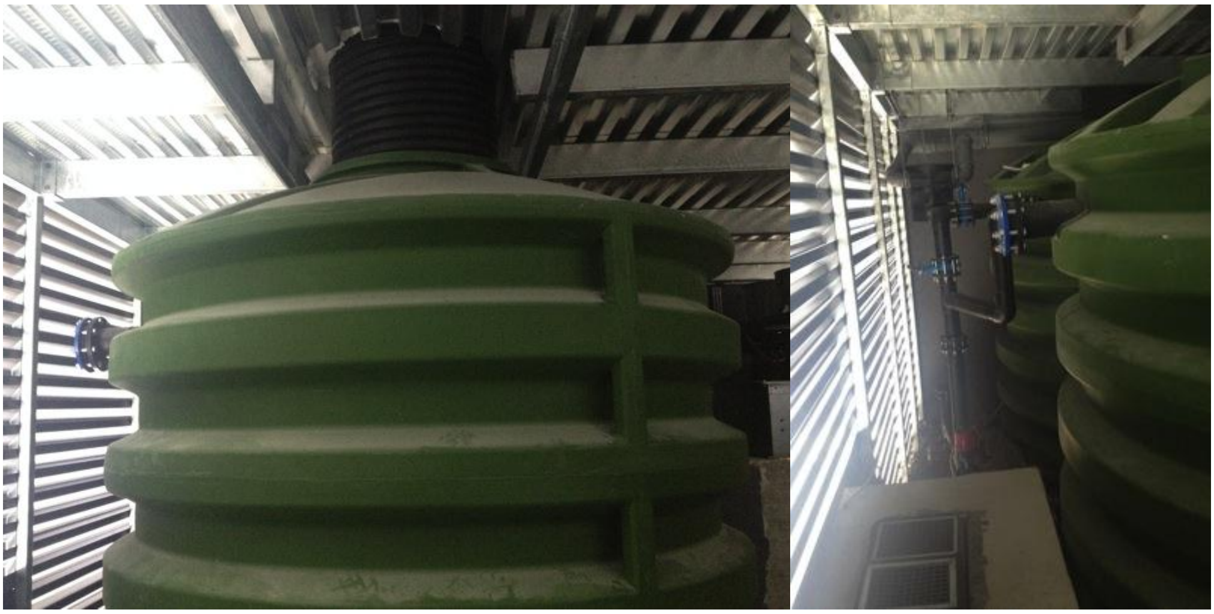
- $PE_{tot,LC;ESH}$ – Total primary energy demand of ESH building (PHPP)
- **$PE_{ren,LC,ESH}$** – Specific primary energy reduction through solar electricity

Table 17: Evaluation of total renewable energy

Share of renewable Primary Energy in Total Primary Energy Demand		
Scale		**Points**
PEren,LC / PEtot,LC ≥ 20% (target value)		50
PEren,LC / PEtot,LC ≥ 18%		45
PEren,LC / PEtot,LC ≥ 16%		40
PEren,LC / PEtot,LC ≥ 14%		35
PEren,LC / PEtot,LC ≥ 12%		30
PEren,LC / PEtot,LC ≥ 10%		25
PEren,LC / PEtot,LC ≥ 8%		20
PEren,LC / PEtot,LC ≥ 6%		15
PEren,LC / PEtot,LC ≥ 4%		10
PEren,LC / PEtot,LC ≥ 2%		5
PEren,LC / PEtot,LC ≥ 0% (limit value)		0
$PE_{tot,LC\ ESH}$ (kWh/m²a)	106,00	
$PE_{ren,LC\ ESH}$ (kWh/m²a)	**6,00**	**15**

6.1.1.10 Water and Waste Water

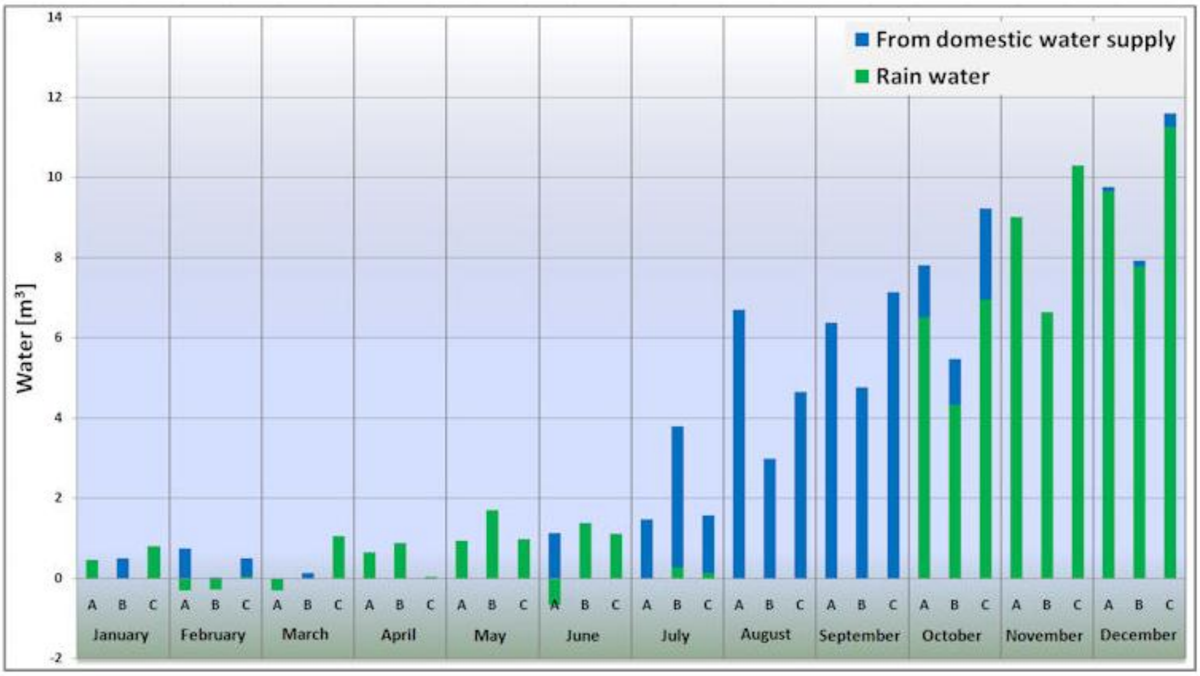
Reference value for water consumption was applied for this indicator. ESH building has rainwater storage tanks installed in the roof of the building. Rain water is used for flushing toilets.



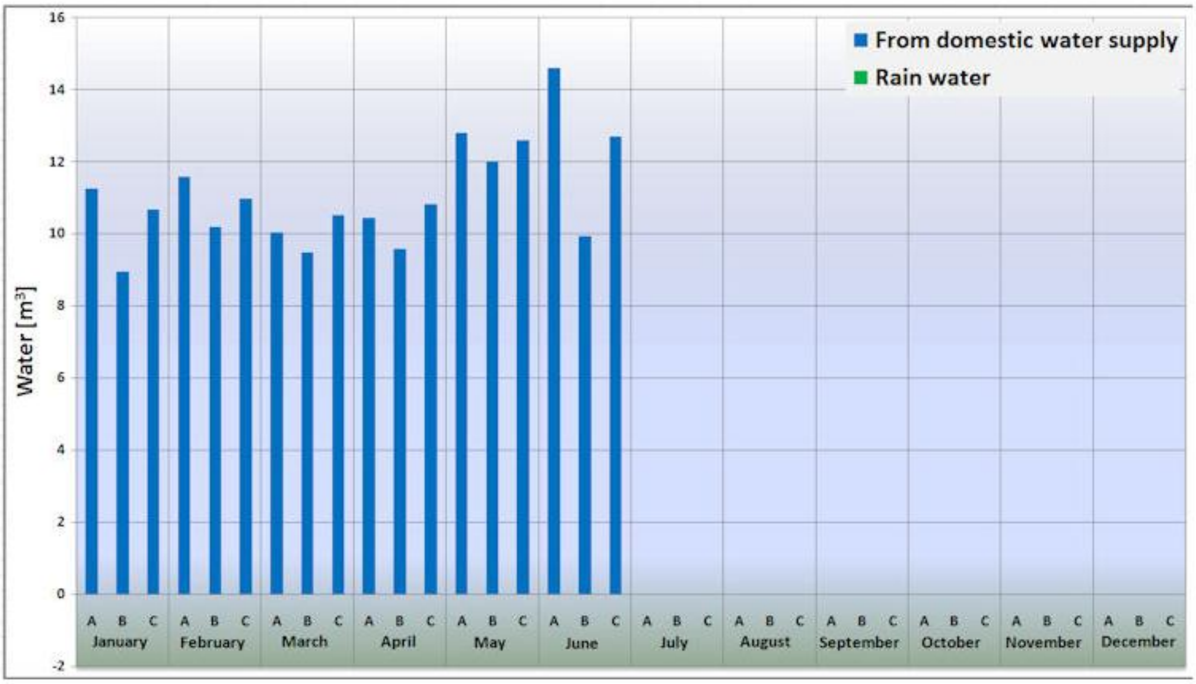
Picture 5: Rainwater storage tanks ESH

Water from rainwater tanks is used for toilet flushing. The following charts shows the use of rainwater for three Eco Silver house parts (Part A, B and C). Saved water is marked with green and domestic water use is marked with blue. Results for year 2015 and 2016.

Charts show results of monitoring of water usage for toilet flushing.



Picture 6: Use of rainwater ESH, year 2015 (Source: SaaS - Cloud services v1.1.9, copyright © 2010-2013. Cybrotech Ltd.)



Picture 7: Use of rainwater ESH, year 2016 (Source: SaaS - Cloud services v1.1.9, copyright © 2010-2013. Cybrotech Ltd.)

Table 18: Criteria for water use

Operational Water Use and Waste Water	
Scale	**Points**
Calculation result for the calculation is available and the calculation result is lower than the dynamic target value: WUV < TV	100
Calculation result for the calculation is available and the calculation result is lower than the dynamic limit value: WUV < R	50
Calculation result for the calculation is available and the calculation result is lower than the dynamic limit value: WUV < L	10
Calculation result for the calculation is available and the calculation result is greater than the dynamic limit value: WUV > L	1
Calculation result for the calculation is not available	0
Indicator evaluation for ESH	**50**

6.1.1.11 Land use

Building is built on area that was already designated as a "building area," without noteworthy contamination. Thera are two sub indicators describing land use value of building.

6.1.1.11a Site location

ESH building has green roof and green areas that cover more than 50% of total property area.

Picture 8: Green roof ESH

Table 19: Evaluation of site location

Site location	
Scale	**Points**
Brownfield redevelopment of contaminated industry and military Locations.	100
Brownfield redevelopment of other types of sites.	70
Previously developed area or undisturbed greenfields with compensatory measures (green roofs or vegetated areas with native and adapted species) covering 50% of the site area.	50
Undisturbed greenfields with compensatory measures (green roofs or vegetated areas with native and adapted species) covering 30% of the site area.	30
Undisturbed greenfields without compensatory measures or prime farmland, protected ecosystems, parks, wetlands.	0
Indicator evaluation for ESH	**50**

6.1.1.11b Imperviousness change

Indicator that evaluates the impervious surfaces (sidewalks, pavements), in relation to site condition prior construction.

There are no significant improvements or losses in the quality of building site.

Table 20: Evaluation of surface coefficient

Imperviousness change	
Scale	**Points**
Improve Imperviousness Surface Coefficient by 0.6	100
Improve Imperviousness Surface Coefficient by 0.5	80
Improve Imperviousness Surface Coefficient by 0.4	70
Improve Imperviousness Surface Coefficient by 0.3	60
Improve Imperviousness Surface Coefficient by 0.2	50
Improve Imperviousness Surface Coefficient by 0.1	40
Preserve existing imperviousness coefficient	30
Degrade Imperviousness Surface Coefficient by 0.1	20
Degrade Imperviousness Surface Coefficient by 0.2	10
Degrade Imperviousness Surface Coefficient by 0.3 or more	0
Indicator evaluation for ESH	**30**

6.1.1.12 Waste

6.1.1.12a Recyclable Waste Storage

Building has ECO islands that meets both requirements of OPEN HOUSE methodology for recyclable waste storage facilities.

Requirement 1 for waste storage:

- Clearly labelled for recycling
- Placed within accessible reach of the building
- In a location with good vehicular access to facilitate collections.

Requirement 2 for waste storage:

- At least 2 m^2 per 1000 m^2 of net floor area for buildings <5000 m^2
- A minimum of 10 m^2 for buildings ≥5000 m^2
- An additional 2 m^2 per 1000 m^2 of net floor area where catering is provided (with an additional minimum of 10 m^2 for buildings ≥5000 m^2).

Table 21: Evaluation of recyclable waste storage

Recyclable Waste Storage	
Scale	**Points**
Compliance with both requirements	100
Compliance with one requirement	70
Not compliant	50
Indicator evaluation for ESH	**100**

6.1.1.12b Composting

There are no composting vessel installed on site for composting suitable food waste.

Table 22: Evaluation of composting

Composting	
Scale	**Points**
Compliant with one of the options	100
Not compliant with any option	0
Indicator evaluation for ESH	**0**

6.1.1.13 Energy efficiency of building equipment (lifts, escalators and moving walkways)

Indicator evaluates the planning of vertical communications.

6.1.1.13a Stairs and ramps

Requirements for stairs and ramps planning:

- Stairs/ramps are visible from building entrance or they can be seen before the lift. Stairs/ramps are see-through or open throughout the occupied floors of the building.
- Travel distance from entrance to the stairs or ramps is less than to the lifts.

Table 23: Evaluation of stairs and ramps planning

Stairs and ramps planning	
Scale	**Points**
Both requirements are fulfilled, and there is clear signage indicating the location of the stairs/ramps	100
One of the two requirements if fulfilled, and there is clear signage indicating the location of the stairs/ramps	70
There is no measure facilitating the use of stair/ramps	50
Indicator evaluation for ESH	**100**

6.1.1.13b Lift design and efficiency

B category of energy efficiency for lifts and analyse of transportation demand pattern was used for the lift design and efficiency evaluation. There are no other vertical communications in the building, so for the escalators and mowing walkway the same amount of points was awarded as for lifts.

Table 24: Evaluation of lift design and efficiency

Lift design and efficiency	
Scale	**Points**
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The energy consumption of the lifts in real time is metered and the information can be easily accessed by the building occupants (e.g. it is available through the network, the internet, or displayed in a visible location like the lift lobby or inside the lifts). The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is A OR All requirements are achieved.	100
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is A OR All requirements are achieved.	90
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is B OR Five of the six requirements are achieved.	80
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is C OR Four of the six requirements are achieved.	70
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is D OR Three of the six requirements are achieved.	60
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is E OR Two of the six requirements are achieved.	50

An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio. The average energy efficiency class for all the lifts in the building as defined by VDI 4707 is F OR One of the six requirements is achieved.	40
An analysis of transport demand and patterns for the building has been carried out by the design team to determine the optimum number and size of lifts and counterbalancing ratio.	20
No analysis was carried.	0
Indicator evaluation for ESH	**80**

6.1.1.14 Contribution to the depletion of abiotic resources - non fossil fuels (ADP_element)

Results ADP_element is not available in eco2soft calculation. Average value of all points awarded for LCA indicators calculated with eco2soft is used to evaluate this indicator. Calculation of average value includes points for awarded to ESH for indicators:

- Global Warming Potential (GWP)
- Ozone Depletion Potential (ODP)
- Acidification Potential (AP)
- Eutrophication Potential (EP)
- Photochemical Ozone Creation Potential (POCP)
- Abiotic depletion of non-renewable fossil fuels due to non-renewable Primary Energy Demand (ADP_Enr)

Average of all points awarded for above indicators is 57,73.

Table 25: Evaluation of ADP_elements

Abiotic Depletion Potential (ADP_elements)		
$ADP_{LC,ESH}$	(kg SB-E /(m²*a)])	57,73

6.1.2 SCORING CARD FOR EVIRONMENTAL QUALITY INDICATORS

Table 26: Scoring card for environmental quality (All indicators assessed)

Environmental Quality							**60,1**
1.1	**Global Warming Potential (GWP)**			**70,37**	**4,00**	**3,59%**	
1.1.1	Global Warming Potential (GWP)	70,37	4				
1.2	**Ozone Depletion Potential (ODP)**			**54,61**	**3,85**	**3,46%**	
1.2.1	Ozone Depletion Potential (ODP)	54,61	4				
1.3	**Acidification Potential (AP)**			**49,57**	**2,29**	**2,05%**	
1.3.1	Acidification Potential (AP)	49,57	4				
1.4	**EutrophicationPotential (EP)**			**49,7**	**2,29**	**2,05%**	
1.4.1	EutrophicationPotential (EP)	49,70	4				
1.5	**Photochemical Ozone Creation Potential (POCP)**			**48,99**	**2,38**	**2,14%**	
1.5.1	Photochemical Ozone Creation Potential (POCP)	48,99	4				
1.7	Biodiversity and Depletion of Habitats			**40**	**2,71**	**2,43%**	
1.7.1	Change in ecological value of the site	40	4				
1.8	Light Pollution			**100**	**2,09**	**1,88%**	
1.8.1	Light on properties	100	4				
1.8.2	Luminaire intensity	100	4				
1.8.3	Upward light	100	4				
1.8.4	Luminance	100	4				
1.9	**Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_Enr)**			**73,11**	**3,55**	**3,19%**	
1.9.1	Abiotic Depletion Potential (ADP_Enr)	73,11	4				
1.10	**Total Primary Energy Demands and Share of Renewable Primary Energy**			**53**	**3,72**	**3,34%**	
1.10.1	Total Primary Energy Demand	37,71	4				
1.10.2	Share of renewable Primary Energy in Total Primary Energy Demand	15	-				
1.11	**Water and Waste Water**			**50**	**2,59**	**2,33%**	
1.11.3	Operational Water Use and Waste Water	50	4				
1.12	**Land use**			**43,33**	**1,95**	**1,76%**	
1.12.1	Site location	50	4				
1.12.2	Imperviousness change	30	2				
1.13	**Waste**			**50**	**2,73**	**2,45%**	

	1.13.1 Recyclable Waste Storage	100	4				
	1.13.2 Composting	0	4				
1.14	Energy efficiency of building equipment (lifts, escalators and moving walkways)			100	2,35	2,11%	
	1.14.1 Stairs and ramps planning	100	4				
	1.14.2 Lift design and efficiency	80	4				
	1.14.3 Escalator design and efficiency	80	4				
	1.14.4 Moving walkway design and efficiency	80	4				
1.15	**Contribution to the depletion of abiotic resources - non fossil fuels (ADPelement)**			**57,725**	**0,60**	**0,54%**	
	1.15.1 Abiotic Depletion Potential (ADPelements)	57,73	4				

6.2 SOCIAL/FUNCTIONAL QUALITY INDICATORS

Social and functional indicators considered and evaluated within OPEN HOUSE methodology are

- **Barrier-free Accessibility**
- Personal Safety and Security of Users
- **Thermal Comfort**
- **Indoor Air Quality**
- Water Quality
- **Acoustic Comfort**
- **Visual Comfort**
- **Operation Comfort**
- Service Quality
- **Public Accessibility**
- Noise from Building and Site
- **Bicycle Amenities**
- **Material Sourcing**

Indicators in this section were assessed based on existing national, international and European building standards, different energy simulations or actual measurements performed during or after construction of ESH building. Results from IDA ICE was the basic energy simulation tool was used for evaluation of indicators for thermal comfort.

The evaluation of indicators in this section is mostly qualitative nature. Points are given in relation to the extent of which the building meets desired criteria for different parameters. Core indicators are in bold.

6.2.1 EVALUATION OF SOCIAL/FUNCTIONAL QUALITY INDICATORS

6.2.1.1 Barrier-free Accessibility

Barrier free accessibility is the indicator that assesses how particular building and different spaces are accessible to people with disabilities.

ESH building from this respect fulfil the national standard (Rules on the requirements for free access to, entry to and use of public buildings and facilities and multi-apartment buildings). According to this standard, rule applies for different building categories, among this categories are also residential buildings with 10 or more apartments that is the case for ESH. ESH building fulfils all of criteria; maximum 100 points are awarded from this section.

Table 27: Evaluation of barrier-free accessibility

Barrier-free Accessibility	Points
The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility. In addition, at least 95% of the work areas (net floor area) and the accessible parts of the outdoor facilities -if existing- are handicapped accessible in compliance with applicable standards or the building standard of the country for barrier free accessibility.	100
The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility. In addition, at least 75% of the work areas (net floor area) and at least 50% of the accessible parts of the outdoor facilities -if existing- are handicapped accessible in compliance with applicable standards or the building standard of the country for barrier free accessibility.	75
The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility. In addition, at least 50% of the work areas (net floor area) are handicapped accessible in compliance with applicable standards or the building standard of the country for barrier free accessibility.	50
The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility. In addition, some work areas are handicapped accessible in compliance with applicable standards or the building standard of the country for barrier free accessibility.	25
The public areas of the building fulfil the building standards of the country or other applicable standards for barrier free accessibility. If there is no building standard for barrier free accessibility the building must be basically handicapped accessible.	10
The building is not barrier free accessible	0
Indicator evaluation for ESH	**100**

6.2.1.2 Personal Safety and Security of Users

Personal safety and security of users aims at assessing the prevention strategies and the preparedness of a building against accidents, disasters, users' health issues, damages and losses of building items. Sub-indicators that evaluate personal safety and security of users are:

- Satisfaction of minimum health and safety requirements in the workplace
- Reduction of the extent of damage if an accident should occur inside and outside the building
- Measures preventing building users from crime

ESH building meets all the demands of national legislation from the field of personal and. safety requirements.

Some of personal safety features integrated in ESH:

- Fenced area with fencing and access control
- Video surveillance in the basement and ground floor
- Fire alarms
- Safety gates in apartments
- Access control biometric fingerprint readers for all shared access and front doors of the apartments
- Access control to the garage, opening with remote control
- Control of windows and balcony doors opening through indicator of openness on the ICC
- Technical security for some common areas with alarm and intervention during the night
- The caretaker of the house during the daytime
- Periodic preventive controls of the parking spaces by police

6.2.1.2a Satisfaction of minimum health and safety requirements

Table 28: Evaluation of health and safety requirements

Satisfaction of minimum health and safety requirements at the workplace	**Points**
All paths are clearly marked, visible, and well lit. Technical safety equipment (emergency telephones, video surveillance, etc.) is present. Emergency telephones are easily recognizable and accessible. Family parking lots*, close to the building, and well lit are available or reserved in case of a building in the design phase. Employees and/or their representatives are informed of all measures to be taken concerning safety and health at the workplace. Electrical installations is designed and constructed so as not to present danger in case of accidents. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.	100
All paths are clearly marked, visible, and well lit. Technical safety equipment (emergency telephones, video surveillance, etc.) is present. Employees and/or their representatives are informed of all measures to be taken concerning safety and health at the workplace. Electrical installations is designed and constructed so as not to present danger in case of accidents. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.	75
Main paths are clearly marked, visible, and well lit. Technical safety equipment (emergency telephones, video surveillance, etc.) is present. Electrical installations is designed and constructed so as not to present danger in case of accidents. The workplace and the equipment and devices are regularly cleaned to an adequate level of hygiene.	50
Main paths are clearly marked, visible, and well lit.	10
Minimum health and safety requirements at the workplace are not satisfied	0
Indicator evaluation for ESH	**100**

6.2.1.2b Reduction of the extent of damage if an accident should occur inside and outside the building

Table 29: Evaluation in case of accidents

Reduction of damage if an accident should occur	Points
Evacuation plans for contaminated air inside the building are present. People with physical limitations (impaired mobility, visually impaired, or hard of hearing) can use the escape routes and/or alternative escape routes are available for these groups.	100
Evacuation plans for contaminated air inside the building are present.	75
Operating instructions are available for ventilation systems in the case of contaminated air inside the building	50
All legal requirements for fire protection and disaster control are fully met.	10
Legal requirements are not met	0
Indicator evaluation for ESH	**100**

6.2.1.2c Measures preventing building users from crime

Table 30: Evaluation of crime preventing measures

Measures preventing building users from crime	Points
Outdoor facilities are under video surveillance even during non-working hours by a person who is available at any time (doorman, security). An alarm system is in place with central monitoring.	100
Contact people (doorman, security) are available even during non-working hours. An alarm system is in place.	75
Contact people (doorman, security) are available during working hours. An alarm system is in place.	50
An alarm system is in place	10
No measure is taken.	0
Indicator evaluation for ESH	**100**

6.2.1.3 Thermal Comfort

The objective of Thermal Comfort Indicator is to provide a comfortable thermal environment supporting productivity and well-being of building occupants, both during summer and winter. Indicators that evaluate thermal comfort of occupants are:

- Operative temperature
- Radiant temperature asymmetry and floor temperature
- Draught, air velocity
- Humidity in indoor air

6.2.1.3a Operative temperature

Operative temperature is the average of the air dry-bulb temperature and of the mean radiant temperature at a given place in a room for air velocities that do not exceed the 0.2m/sec. Evaluation of Operative Temperature is based on EN 15251 and EN 7730.

Operative temperatures meet the criteria for recommended indoor temperatures according to EN 15251 for residential buildings and HVAC systems. Operative temperature for heating (winter season) are in accordance to Category I.

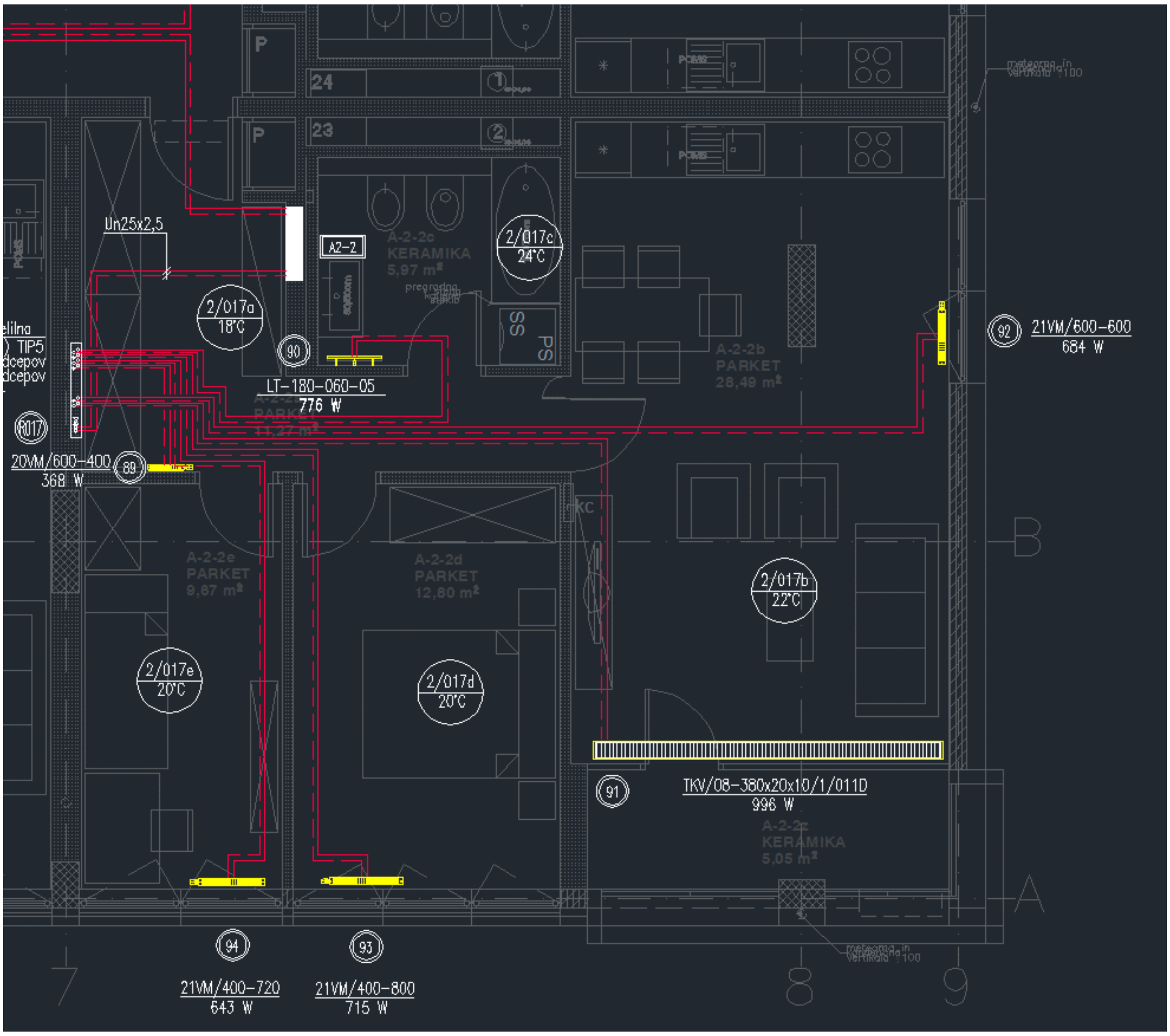
Table A.2 — Examples of recommended design values of the indoor temperature for design of buildings and HVAC systems

Type of building/ space	Category	Operative temperature °C	
		Minimum for heating (winter season), ~ 1,0 clo	Maximum for cooling (summer season), ~ 0,5 clo
Residential buildings: living spaces (bed rooms, drawing room, kitchen etc) Sedentary ~ 1,2 met	I	21,0	25,5
	II	**20,0**	**26,0**
	III	18,0	27,0
Residential buildings: other spaces: storages, halls, etc) Standing-walking ~ 1,6 met	I	18,0	
	II	**16,0**	
	III	14,0	

Picture 9: Operating temperatures EN 15251

Design temperatures of ESH building for different rooms in apartments are:

- Kitchens: 22°C
- Living rooms: 22°C
- Bathrooms: 24°C
- Bedrooms: 20°C



Picture 10: Design temperatures ESH – Typical apartment (ESH project documentation)

Operative temperature for cooling (summer season) are in accordance to Category II of the EN 15251. Operative temperature for cooling is 26 ºC.

50 points were awarded to ESH for winter conditions and 25 for summer conditions.

Table 31: Evaluation of operative temperatures

Operative Temperature (Winter)	Points
Compliance with Category I of EN 15251/ EN ISO 7730 OR compliance with EN 12831 (minimum room temperature 21°C)	**50**
Compliance with Category II of EN 15251/ EN ISO 7730 OR compliance with EN 12831 (minimum room temperature 20°C)	25
Compliance with Category III of EN 15251/ EN ISO 7730 OR compliance with minimum national criteria, whatever is more restrictive	5
No compliance with minimum national criteria	0

Operative Temperature (Summer)	Points
Compliance with Category I of EN 15251/ EN ISO 7730 AND Compliance with national standards to avoid summerly overheating	50
Compliance with Category III of EN 15251/ EN ISO 7730 AND compliance with national standards to avoid summerly overheating	**25**
Compliance with Category III of EN 15251/ EN ISO 7730 AND compliance with national standards to avoid summerly overheating	15
Compliance with national standards to avoid summerly overheating	10
No compliance with minimum national criteria	0
Indicator evaluation for ESH	**75**

6.2.1.3b Radiant temperature asymmetry and floor temperature

Radiant asymmetry can cause thermal discomfort and people are most sensitive to asymmetry caused by warm ceiling or cool walls (windows).

Radiant temperature asymmetry and floor temperature is in compliance with (EN 7730) Category A.

Table A.4 — Radiant temperature asymmetry

Category	Radiant temperature asymmetry °C			
	Warm ceiling	Cool wall	Cool ceiling	Warm wall
A	< 5	< 10	< 14	< 23
B	< 5	< 10	< 14	< 23
C	< 7	< 13	< 18	< 35

Picture 11: Radiant temperature asymmetry EN 7730 Radiant

Table A.3 — Range of floor temperature

Category	Floor surface temperature range °C
A	19 to 29
B	19 to 29
C	17 to 31

Picture 12: Floor temperatures EN 7730

Simulation of radiant temperatures asymmetry was performed with IDA ICE for a typical apartment in ESH in winter and summer conditions.

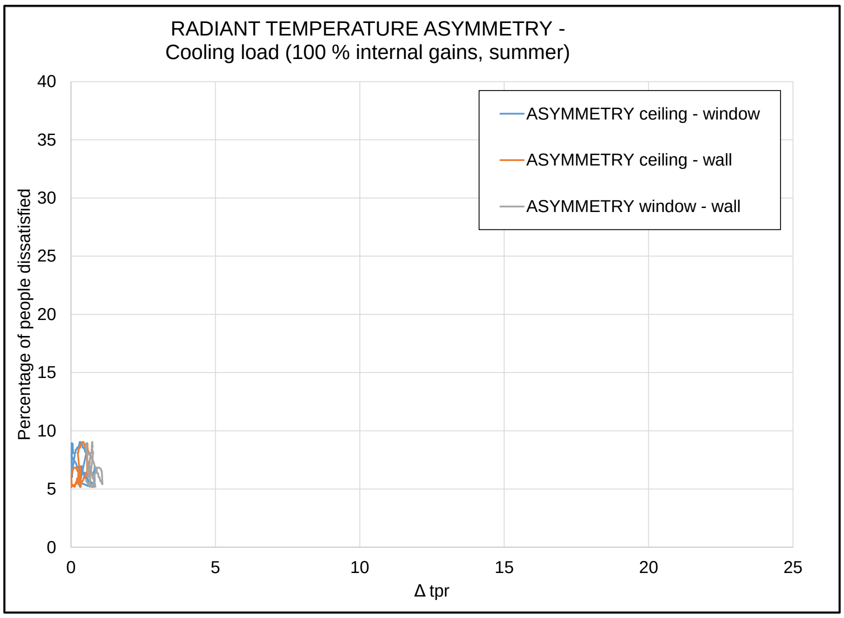


Chart 1: Radiant temperatures asymmetry – cooling load – ESH simulation by IDA ICE

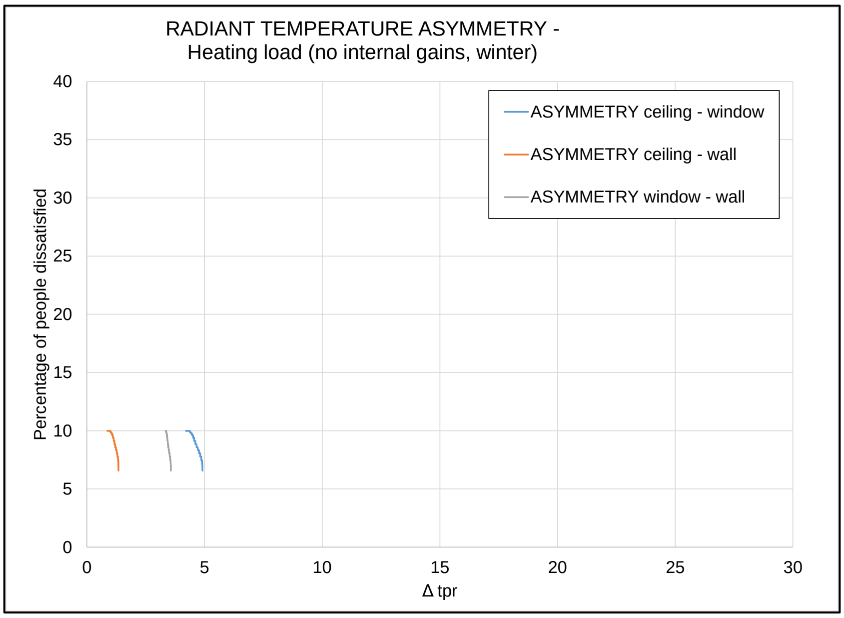


Chart 2: Radiant temperatures asymmetry – heating load - ESH simulation by IDA ICE

Table 32: Evaluation of temperature asymmetry

Radiant temperature asymmetry and floor temperature	Points
Values are compliant (EN 7730) Category A,B	100
Values are compliant (EN 7730) Category C	50
Values are not compliant (EN 7730)	0
Indicator evaluation for ESH	**100**

6.2.1.3c Draught, air velocity

Air drafts on part of the body affect the thermal comfort of the occupant. For different types of spaces, the maximum mean air velocity is defined in ISO EN 7730.

According to Slovenian legislation (Rules on the ventilation and air-conditioning of buildings) the mean air velocity is 0,15 m/s for heating period and 0,2 m/s outside heating period, which places the ESH in category II of EN 7730.

Table 33: Evaluation of draught, air velocity

Draught, air velocity	Points
Compliant with Category I, II EN ISO 7730, paragraph A4, Table A5	100
Compliant with Category III EN ISO 7730, paragraph A4, Table A5	50
Non-compliant with Category I, II, III EN ISO 7730, paragraph A4, Table A5	0
ESH evauation	**100**

6.2.1.3d Humidity in indoor air

The upper limit for absolute humidity (perceived humidity) of 12 g of water per kg of dry air should not be exceeded (based on EN 15251, appendix B3). Humidity in apartments is compliant with all standards.

Table 34: Evaluation of humidity

Humidity in indoor air	Points
Absolute humidity of 12 g of water per kg of dry air compliant	100
Absolute humidity of 12 g of water per kg of dry air non-compliant	0
ESH evauation	**100**

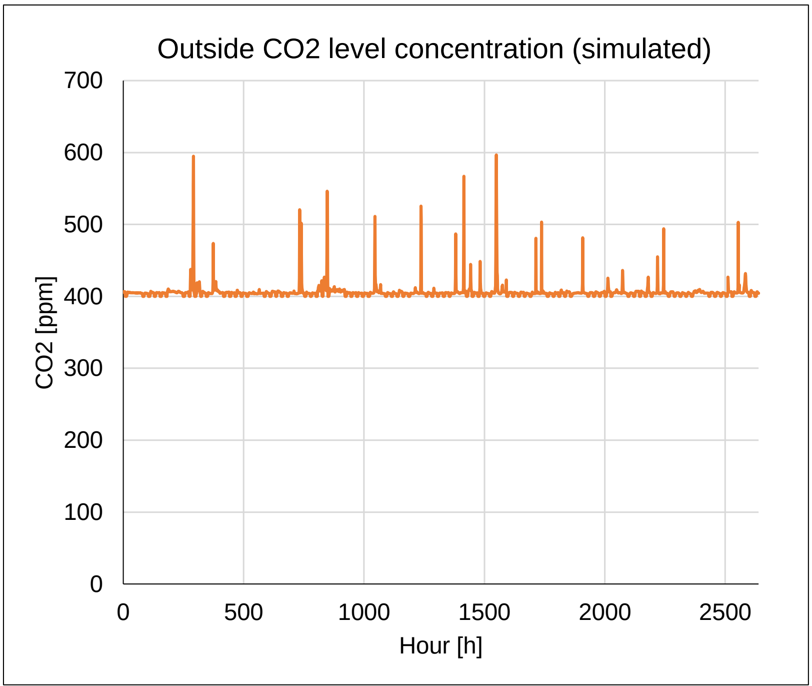
6.2.1.4 Indoor Air Quality

Indoor air quality (IAQ) is one of the factor that determine building functionality and economics. The goal is to assure the indoor air quality and to avoid negative impacts on the user´s state of health. This indicator supports the objective of the European Commission to ensure that enclosed workplaces are provided with sufficient clean and fresh air.

Sub indicators that evaluate IAQ are:

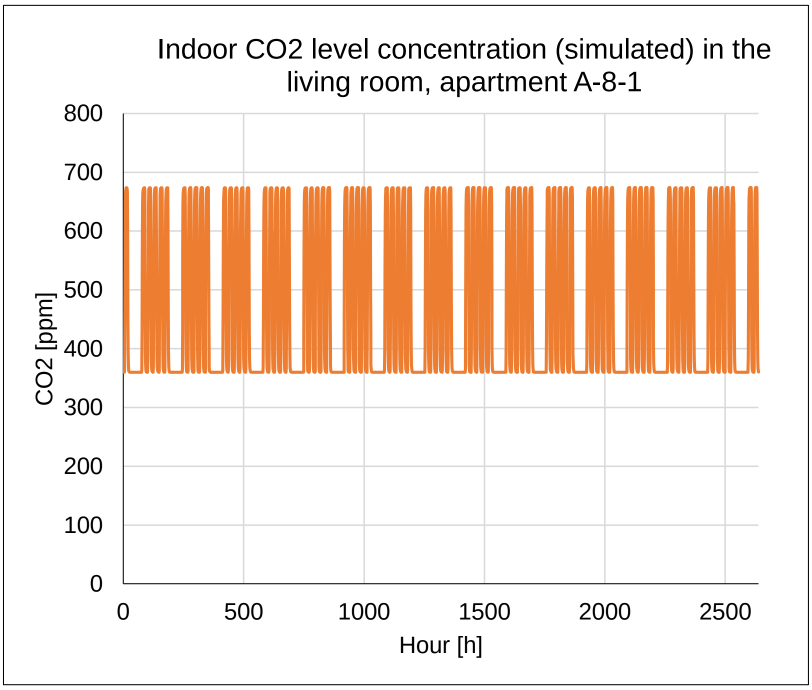
- Occupancy-based ventilation rates
- Indoor air contamination with the most relevant indoor air pollutants (formaldehyde, naphthalene, toluene, xylene, styrene) [Existing buildings]
- CO_2 concentration above outdoor level [Existing buildings]
- Subjective reaction as classification of the indoor air quality [Existing buildings]
- Occurrence of Radon

Level of CO_2 during operation was simulated with IDA ICE software. Results show, that the level of CO_2 should not exceed the 700 PPM in the living room of typical apartment. Outdoor level of CO_2 concentration in last years in Ljubljana is between 350 in 400 PPM according to all relevant public documents (Operational programme to reduce greenhouse emissions by 2020[4]). Simulation was performed for CO_2 levels for indoor and outdoor environment. Relative indoor concentration of CO_2 does not exceed 300 PPM. Ventilation should be sufficient also for other indoor air pollutants.

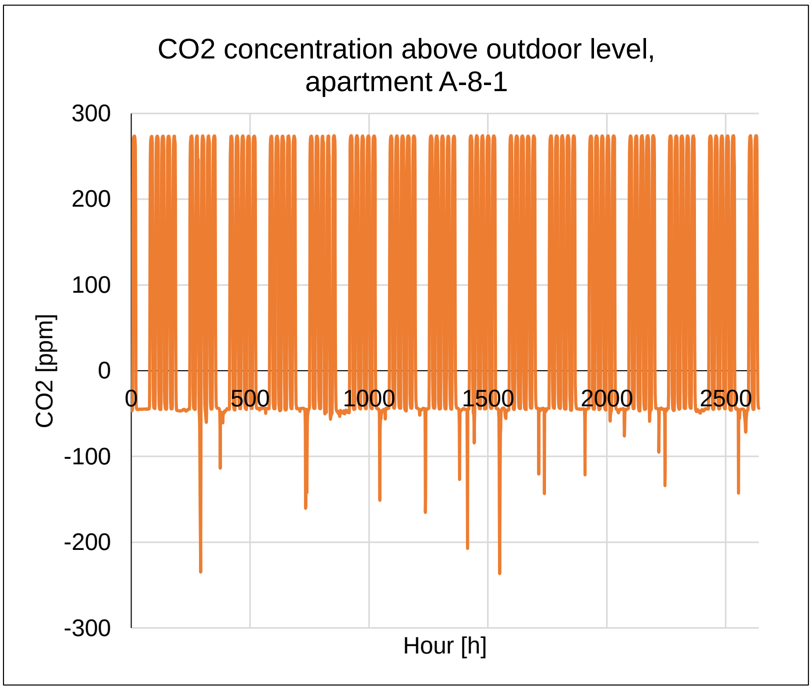


Picture 13: Outside CO_2 concentration; simulated; IDA ICE

[4] http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/op_tgp/op_tgp_2020.pdf



Picture 14: Absolute concentration of CO_2; simulated; IDA ICE



Picture 15: Relative concentration of CO_2; simulated; IDA ICE

6.2.1.4a Occupancy-based ventilation rates

Every apartment in ESH has mechanical ventilation with heat recovery installed. Mechanical ventilation is designed according to technical standards and takes into account 35 m^3/h of fresh air per person per hour. This design ventilation rate places ESH ventilation in Category I according to EN 15251.

Table B1. Basic required ventilation rates for diluting emissions (bio effluents) from people for different categories

Category	Expected Percentage Dissatisfied	Airflow per person l/s/pers
I	15	1O
II	20	7
III	30	
IV	> 30	< 4

Picture 16: Required ventilation rates EN 15251

Table 35: Evaluation of occupancy based ventilation rates

Occupancy-based ventilation rates	**Points**
Category I	100
Category II	75
Category III or national regulations	10
Category IV	0
Indicator evaluation for ESH	**100**

6.2.1.4b Indoor air contamination with the most relevant indoor air pollutants (formaldehyde, naphthalene, toluene, xylene, styrene) [Existing buildings]

Mechanical ventilation in apartments is equipped with VOC sensor for relevant air pollutant that monitor indoor air quality and automatically adjust ventilation rates.

Since the ventilation can be regulated automatically, the quality of indoor air quality can be sufficient all the time if this option is chosen.

Table 36: Evaluation of indoor air contamination

Indoor air contamination with the most relevant indoor air pollutants: Formaldehyde	**Points**
<10 µg/m3	**20**
<10-60 µg/m3	15
<60-100 µg/m3	5
>100 µg/m3	0
Indoor air contamination with the most relevant indoor air pollutants: Naphthalene	**Points**
<2 µg/m3	**20**
<2-5 µg/m3	15
<5-10 µg/m3	5
>10 µg/m3	0
Indoor air contamination with the most relevant indoor air pollutants: Toluene	**Points**
<5 µg/m3	**20**
<5-80 µg/m3	15
80-100 µg/m3	10
<180-250 µg/m3	5
>250 µg/m3	0
Indoor air contamination with the most relevant indoor air pollutants: Styrene	**Points**
<2 µg/m3	**20**
<2-20 µg/m3	15
<20-30 µg/m3	5
>30 µg/m3	0
Indoor air contamination with the most relevant indoor air pollutants: Xylenes	**Points**
<5 µg/m3	**20**
<5-30 µg/m3	15
<30-80 µg/m3	10
<80-150 µg/m3	5
>150 µg/m3	0
Indicator evaluation for ESH	**100**

6.2.1.4c CO_2 concentration above outdoor level [Existing buildings]

Level of CO_2 can be regulated through VOC sensor in ventilation system. Since the ventilation can be regulated automatically, the quality of indoor air quality can be sufficient all the time if this option is chosen.

Table 37: Evaluation of CO_2 concentration

CO_2 concentration above outdoor level	Points
< 300 PPM above outdoor level	100
<400 PPM	80
<500 PPM	50
<600 PPM	30
<700 PPM	20
<800 PPM	10
>800 PPM above outdoor level	0
Indicator evaluation for ESH	**100**

6.2.1.4d Subjective reaction as classification of the indoor air quality [Existing buildings]

The use of subjective evaluations has been introduced in the standard EN 15251. By using all or some of the scales recommended in Annex H of this standard the occupants are asked to fill in the questionnaires. Indoor air quality evaluated as good to very good.

Table 38: Subjective indoor air quality

Subjective reaction as classification of the indoor air quality	Points
> 80-100% good or very good	100
>70%	80
>75%	60
>70%	40
>60%	20
Below 50 % satisfied	0
Indicator evaluation for ESH	**100**

6.2.1.4e Occurrence of Radon

Indoor radon concentration levels of 200 and 400 Becquerel per cubic meter (Bq/m^3) are the reference concentrations in buildings above which mitigation measures should be taken in order to reduce exposure to radon.

No measurements of Redon concentration have been performed. Four out of five measures for reduction of Radeon defined by OPEN HOUSE methodology can be considered indirectly as fulfilled by ESH. Measures by OPEN HOUSE:

- Installing a radon sump system
- Sealing floors and walls
- Increasing under floor ventilation
- Installing a whole building positive pressurisation or positive supply ventilation system
- Improving the ventilation of the building

There is no radon sump system installed in ESH. Ventilation of building is good. Airtightness of building n_{50} is below 0,6h^{-1}.

Table 39: Evaluation of Radeon

Occurrence of Radon	**Points**
Indoor radon concentration < 400 Bq/m3	100
Indoor radon concentration > 400 Bq/m3 AND 4 out of 5 attenuation measures taken	75
Indoor radon concentration > 400 Bq/m3 AND 2 out of 5 attenuation measures taken	50
Indoor radon concentration > 400 Bq/m3 and no attenuation measures taken	0
Indicator evaluation for ESH	**75**

6.2.1.5 Water Quality

The objective of the indicator is to evaluate the water quality in a building in order to protect users health, ensure a reliable water supply, etc. Sub-indicators that evaluate water quality are:

- Constant Water Supply through the day/ year (Reliable water supply)
- Use of alternative water supplies
- Water Disinfection

Evaluation of sub indicators is below.

6.2.1.5a Constant Water Supply through the day/ year (Reliable water supply)

Table 40: Evaluation of water supply

Constant water supply through the day/year	Points
Constant water supply through the day/year	100
No constant water supply	0
Indicator evaluation for ESH	**100**

6.2.1.5b Use of alternative water supplies

Table 41: Evaluation of alternative water supply

Use of Alternative water supplies	Points
Water supplied from municipal / private water supply only OR use of alternative water supply with a Water Safety Plan	100
Use of alternative water supplies with no Water Safety Plan	0
Indicator evaluation for ESH	**100**

6.2.1.5c Water Disinfection

Table 42: Evaluation of disinfection

Ozonation instead of chlorination for water disinfection	Points
Ozonation instead of chlorination for water disinfection	100
Not compliant	0
Indicator evaluation for ESH	**0**

6.2.1.6 Acoustic Comfort

The aim is to achieve a low level interference and background noise with speech intelligibility in all rooms to avoid affecting use, health and capability of the users.

Sub indicators that evaluate acoustic performance of indoor environment are:

- Indoor ambient noise levels in unoccupied staff/office areas
- Reverberation period

6.2.1.6a Indoor ambient noise levels in unoccupied staff/office areas

Indoor level of noise is prescribed by national legislation (Rules on protection against noise in buildings and Technical guideline TSG-1-005:2012 Protection against noise in buildings)

Level of noise in apartments defined in national legislation must not exceed value of 35 dB (A) during the day, 33 dB (A) during evening and 30 33 dB(A) during the night.

Noise levels in apartments of ESH building are not exceeded.

Table 43: Evaluation of ambient noise levels

Indoor ambient noise levels in unoccupied staff/office areas	**Points**
Compliance with all the requirements	100
Compliance with four of the requirements	80
Compliance with three of the requirements	60
Compliance with two of the requirements	40
Compliance with one of the requirements	20
Not compliance with any of the requirements	0
Indicator evaluation for ESH	**100**

6.2.1.6b Reverberation period

Reverberation period is described on national level in Rules on protection against noise in buildings and Technical guideline TSG-1-005:2012 Protection against noise in buildings. Reference reverberation period for furnished apartment is in the region 0,5s.

ESH reverberation period is in range of recommended value of 0,5. Evaluation of this indicator was slightly changed. Recommended value of reverberation period is evaluated as 100 points, since the longer and also shorter reverberation periods tend to bring discomfort.

Table 44: Evaluation of reverberation period

Reverberation period ESH apartments	**Points**
$0,4 \leq T \leq 0,6$ s	100
$0,3 \leq T \leq 0,4$ and $0,6 \leq T \leq 0,8$	50
$T \leq 0,3$ and $T > 0,8$	0
Indicator evaluation for ESH	**100**

6.2.1.7 Visual Comfort

By an early and integral daylight and artificial light planning, a high quality of illumination can be created with low energy demands for illumination and cooling.

Sub indicators that evaluate visual comfort:

- Availability of daylight throughout the building
- Availability of daylight in regularly used work areas
- View to the outside
- Preventing glare in daylight
- Preventing glare in artificial light
- Light distribution in artificial lighting conditions
- Colour rendering
- Blinking and flashing lights

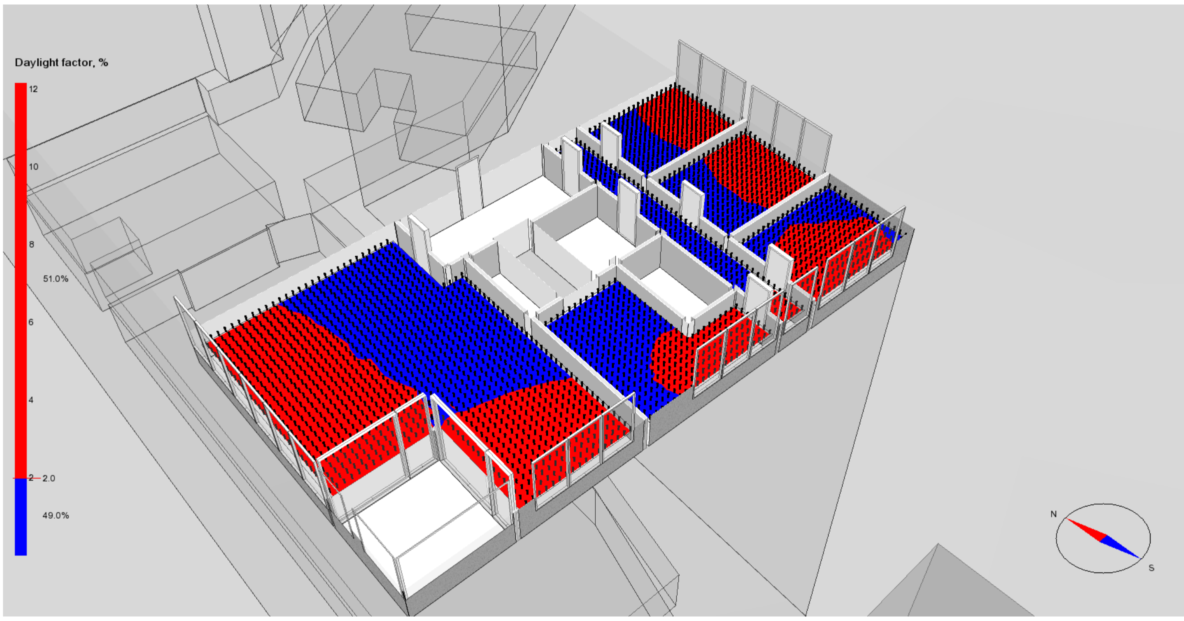
6.2.1.7a Availability of daylight throughout the building

Availability of daylight was calculated for typical apartment with IDA ICE. Indicator is determined via the daylight factor.

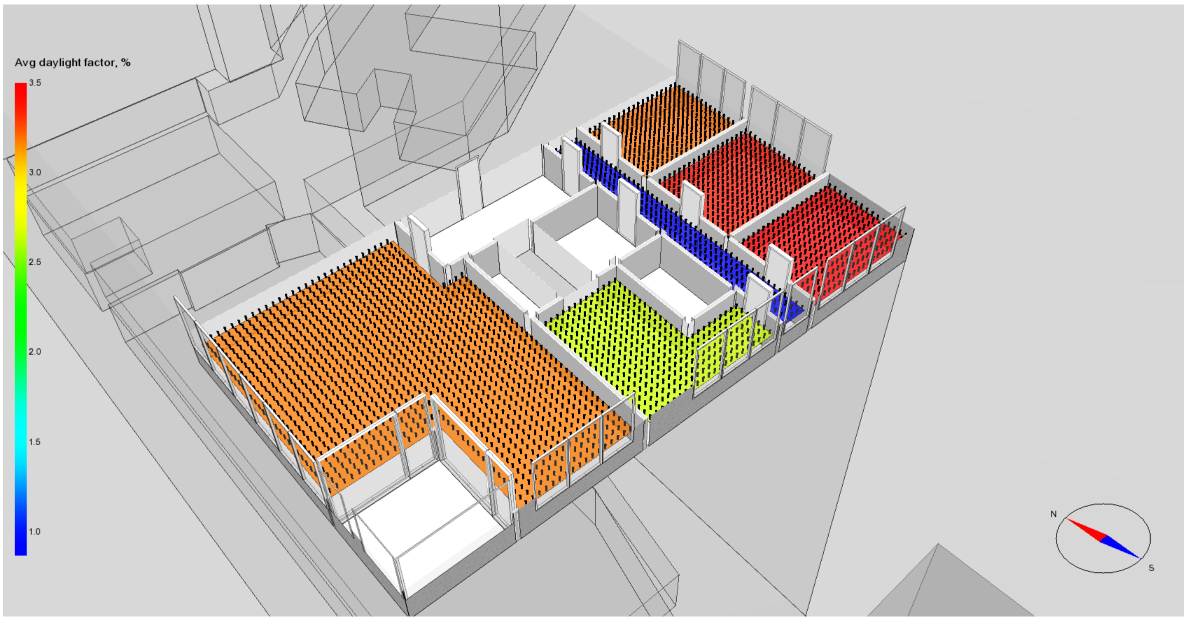
In typical apartment the daylight factor is higher than 2 for 51% of flor area. Result shows very good performance of this indicator.

Table 45: Evaluation of daylight availability (building)

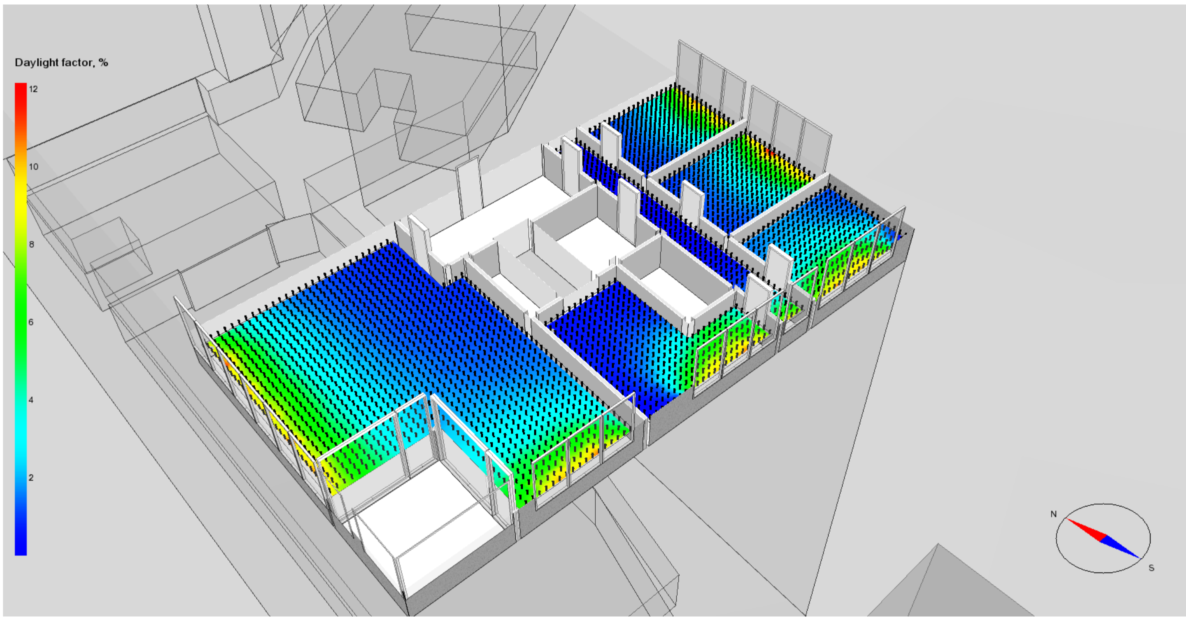
Availability of daylight throughout the building	**Points**
50% of UA has a daylight factor >2%	100
50% of UA has a daylight factor >1,5%	75
50% of UA has a daylight factor >1%	50
50% of UA has a daylight factor <1%	0
Indicator evaluation for ESH	**100**



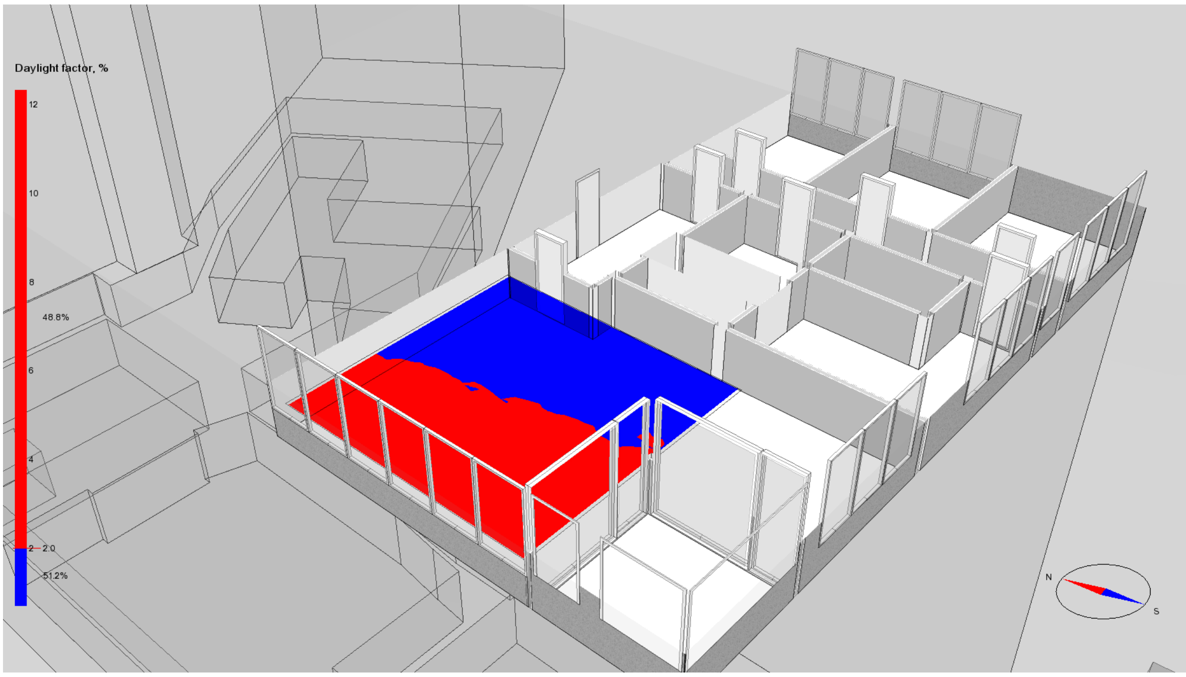
Picture 17: IDA ICE, daylight factor limit value = 2, apartment A-8-1



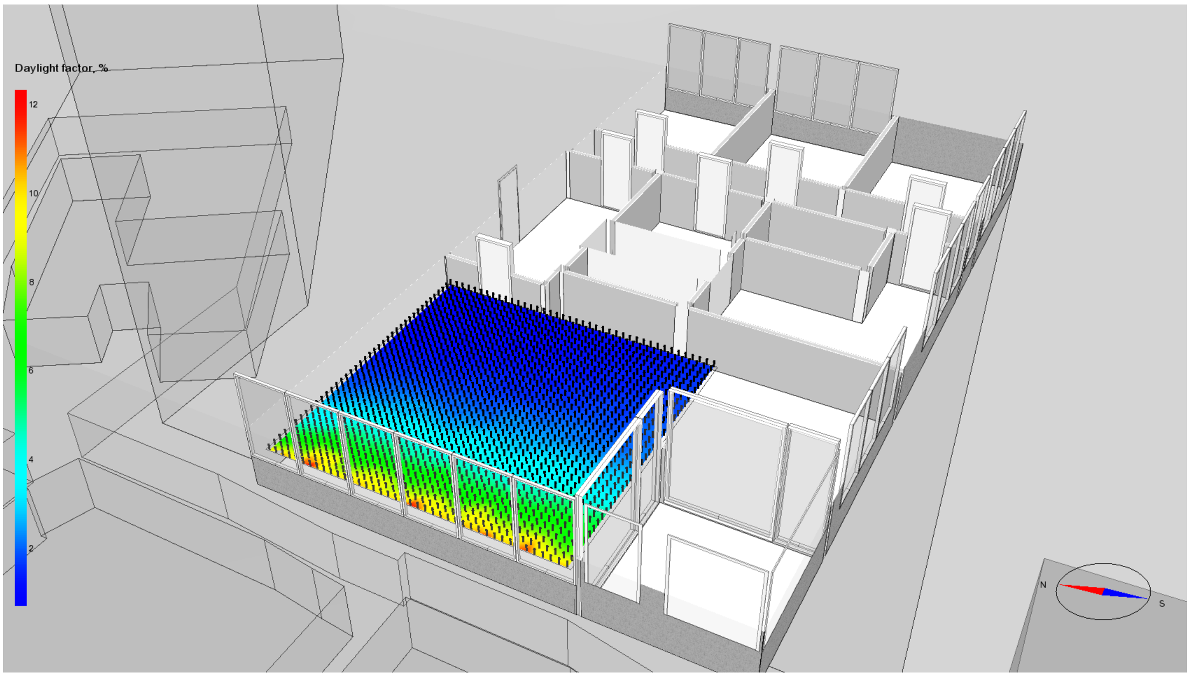
Picture 18: IDA ICE, average daylight factor, apartment A-8-1



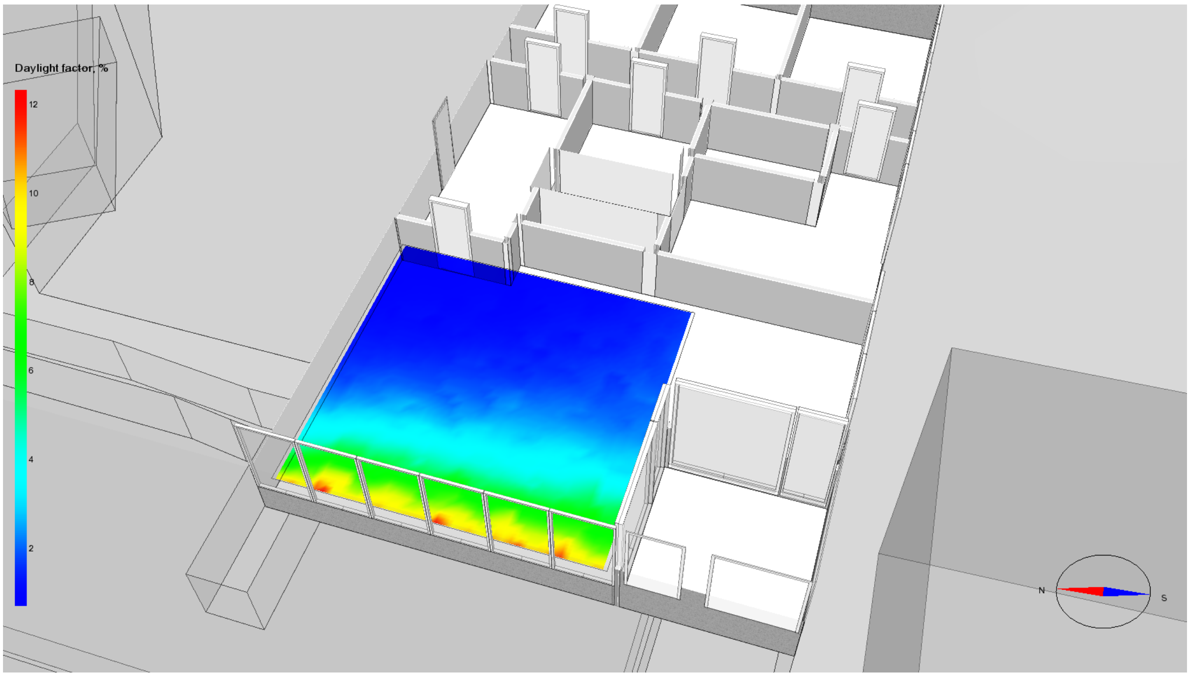
Picture 19: daylight factor, apartment A-8-1



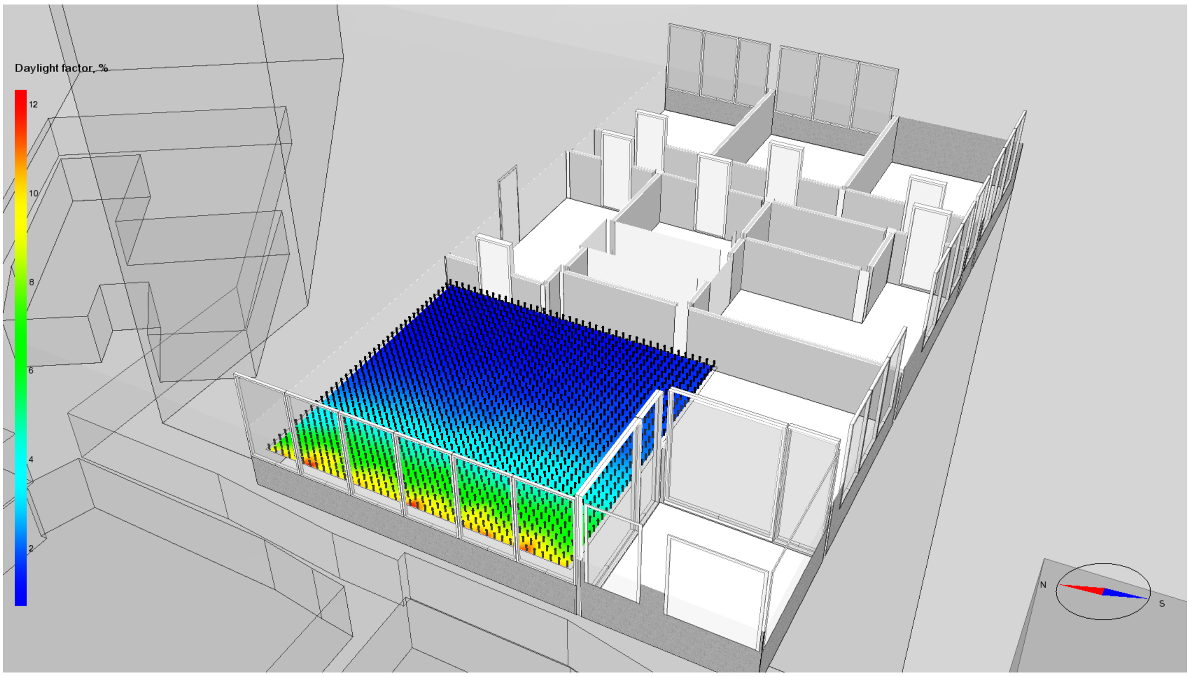
Picture 20: IDA ICE, daylight factor limit value = 2, room in apartment A-8-1



Picture 21: IDA ICE, daylight factor simulation, room in apartment A-8-1



Picture 22: IDA ICE, daylight factor simulation, room in apartment A-8-1



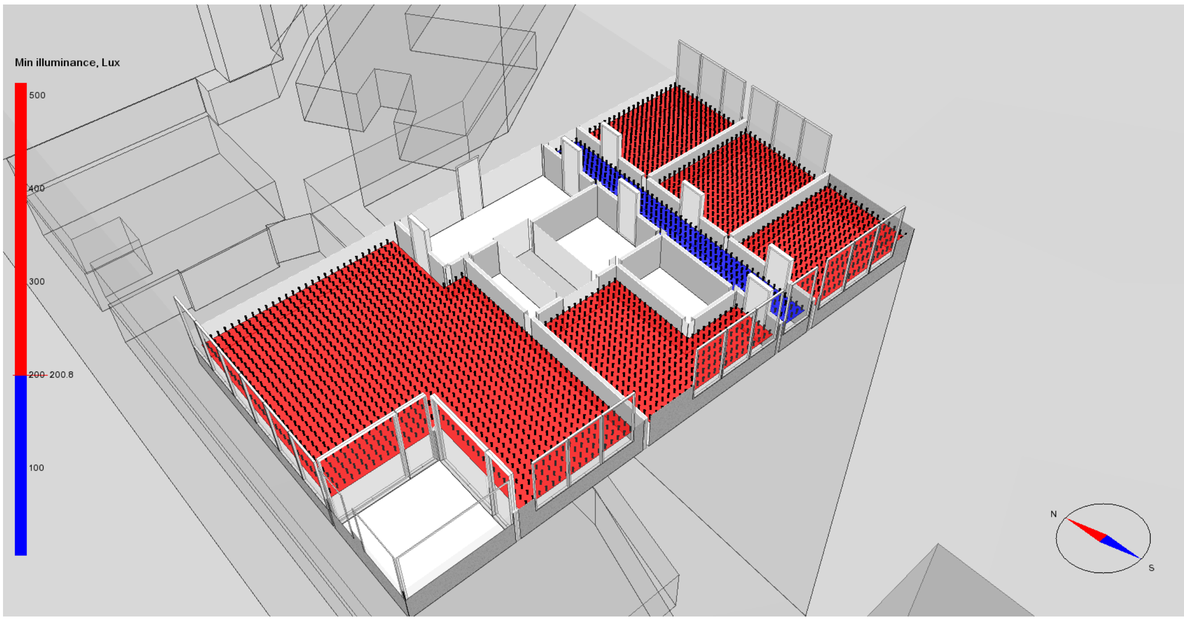
Picture 23: ICE, daylight factor simulation, room in apartment A-8-1

6.2.1.7b Availability of daylight in regularly used work areas

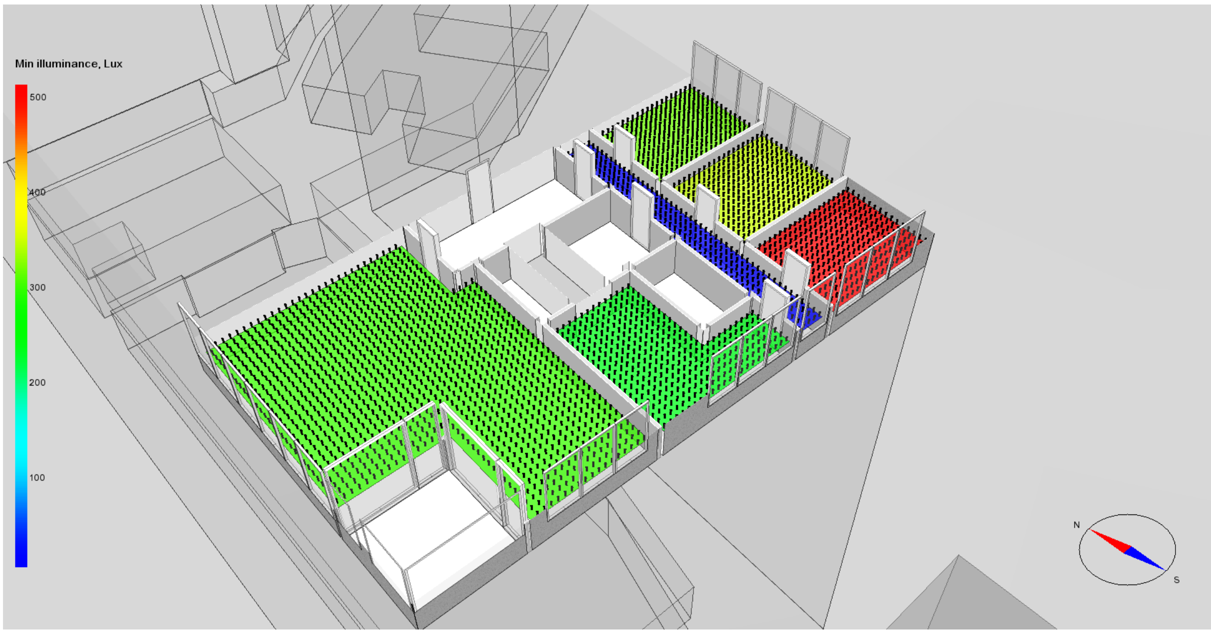
Illuminance was calculated with IDA ICE simulation tool for the typical apartment. Limiting value for livings spaces in apartment buildings is 200 Lux. Result of simulation shows that the minimal requirements regarding illuminance are satisfied for typical apartment in ESH building.

Table 46: Evaluation of daylight availability (typical apartment)

Availability of daylight in regularly used work areas	**Points**
Annual relative lighting percentage > 80%	100
Annual relative lighting percentage between 60 and 80%	75
Annual relative lighting percentage between 45 and 60%	50
Annual relative lighting percentage < 45%	0
Indicator evaluation for ESH	**100**



Picture 24: IDA ICE, Min illuminance, limit value = 200 Lux (living spaces), apartment A-8-1



Picture 25: Min illuminance, (living spaces), apartment A-8-1

6.2.1.7c View to the outside

View to the outside is an important requirement because it is in the spirit of sustainable and user-oriented planning and is necessary for user satisfaction in constantly occupied areas.

Shading devices in ESH are automatically controlled depending on the amount of solar radiation.

Table 47: Evaluation of view to outside

View to the outside	**Points**
A view to the outside is still possible when sun shades are closed.	100
A view to the outside is still possible when sun shades are activated, by adjusting them (Cut-Off-position, sun tracking control)	75
A view to the outside is not possible anymore when sun shades are activated.	0
Indicator evaluation for ESH	**75**

6.2.1.7d Preventing glare in daylight

The assessment of glare prevention in daylight includes the planned antiglare system, which may be the same as the sun-shade system. There are no additional glare preventing systems installed in ESH.

Table 48: Evaluation of glare in daylight

Preventing glare in daylight	**Points**
Light-guiding system in combination with a glare protection system forcing direct light to fade	100
Presence of a glare protection system	75
No glare protection system	0
Indicator evaluation for ESH	**75**

6.2.1.7e Preventing glare in artificial light

Artificial lighting is compliant with national standards.

Table 49: Evaluation of artificial lighting

Preventing glare in artificial light	**Points**
Compliant	100
Not compliant	0
Indicator evaluation for ESH	**100**

6.2.1.7f Light distribution in artificial lighting conditions

Light distribution is compliant with national standards

Table 50: Evaluation of light distribution

Light distribution in artificial lighting conditions	**Points**
Compliant	100
Not compliant	0
Indicator evaluation for ESH	**100**

6.2.1.7g Colour rendering

Colour rendering and light colour in daylight and artificial light conditions influences user perception and acceptance. CRI index of commonly used light bulbs (OSRAM TC-D DULUX D-E 26W-840) is 83 that places them in the middle interval between 80 and 90.

Table 51: Evaluation of colour rendering

Colour rendering	**Points**
Color rendering index for artificial light and day light > 90	100
Color rendering index for artificial light and day light between 80 and 90	50
Color rendering index for artificial light and day light < 80	0
Indicator evaluation for ESH	**50**

6.2.1.7h Blinking and flashing lights

The presence of blinking, flashing and coloured lighting that may cause irritation, loss of concentration, should be assessed. There are no blinking and flashing lights installed on the building.

Table 52: Evaluation of blinking light

Blinking and flashing lights	**Points**
No blinking and flashing lights on the buildings	100
Existence of blinking and flashing lights on the building	0
Indicator evaluation for ESH	**100**

6.2.1.8 Operation Comfort

Operation comfort is an indicator describing the possibilities of the user to control or have an impact on the parameters of the indoor environment. It includes the following sub indicators that affect and determine the living environment:

- Ventilation,
- Shading
- Glare prevention,
- Temperatures during the heating season,
- Temperatures outside the heating season,
- Control of daylight and artificial light,
- Ease of operation.

Every apartment has automatic central control unit where all of the above parameters can be set that include (Ventilation ratings, shading, temperatures during heating season, control of daylight and artificial light). Temperatures outside heating period are regulated indirectly by shading and daylight regulation.

Colling of all apartments is by electric air conditioners that are regulated manually.

Picture 26: Control unit in apartments

6.2.1.8a Ventilation

Table 53: Ventilation control

Ventilation	Points
Room air exchange controllable (max. 3 persons)	100
Zone air exchange controllable (more than 3 persons)	50
No air exchange control	0
Indicator evaluation for ESH	**100**

6.2.1.8b Shading

Table 54: Shading control

Shading	Points
Shading control for a room (max. 3 persons)	100
Shading control for a zone (more than 3 persons)	50
No shading control	0
Indicator evaluation for ESH	**100**

6.2.1.8c Glare prevention

Table 55: Glare control

Glare prevention	Points
Glare prevention control for a room (max. 3 persons)	100
Glare prevention control for a zone (more than 3 persons)	50
No glare prevention control	0
Indicator evaluation for ESH	**100**

6.2.1.8d Temperatures during the heating season

Table 56: Temperature control – heating period

Temperatures during the heating period	Points
Room temperature control (max. 3 persons)	100
Zone temperature control (more than 3 persons)	50
No temperature control	0
Indicator evaluation for ESH	**100**

6.2.1.8e Temperatures outside the heating season

Table 57: Temperature control – outside heating period

Temperatures outside the heating period	Points
Room temperature control (max. 3 persons)	100
Zone temperature control (more than 3 persons)	50
No temperature control	0
Indicator evaluation for ESH	**100**

6.2.1.8f Control of daylight and artificial light

Table 58: Light regulation

Regulation of daylight and artificial light	Points
Light level control for a room (max. 3 persons)	100
Light level control for a zone (more than 3 persons)	50
No control on daylight or artificial light	0
Indicator evaluation for ESH	**100**

6.2.1.8g Ease of operation

Table 59: Evaluation of operation comfort

Ease of operation	Points
Central display and management of operation comfort indicators/functions: ventilation, shading, glare, temperatures, lighting, as an overall solution; for example use of web browser to operate with indicators	100
Central display and management of operation comfort indicators/functions: ventilation, temperatures, lighting, as an overall solution; for example use of web browser to operate with indicators	75
Separate/local management (i.e. switch)and display of operation comfort indicators/functions: ventilation, temperatures	50
Separate/local management (i.e. switch) without display of operation comfort indicators/functions: ventilation, shading, glare, temperatures, lighting	0
Indicator evaluation for ESH	**100**

6.2.1.9 Service Quality

Service quality of the building is evaluated in order to examine the availability and quantity of services in it as well as the connected outdoor areas. Sub-indicators addressing service quality are:

- Availability of services in the building or in direct proximity to the building
- Service integration in building connected outdoor areas

Service quality is a measure of how well the service level delivered in a building matches user expectations.

6.2.1.9a Availability of services in the building or in direct proximity to the building

Services that are the part of evaluation and influence the indicator performance are:

- Recreation or relaxation areas
- Restaurant or cafeteria, kitchen (within 100m from building)
- Sport centre (within 100m from building)
- Elderly care / Child care
- Medical facilities and personnel
- Concierge service
- Post / Courier services

Restaurant and relaxation areas are taken into account for this indicator.

Table 60: Evaluation of services

Availability of services in the building	Points
At least 4 of the 7 services are present	100
3 of the 7services are present	75
2 of the 7 services are present	30
1 of the 7 services is present	10
None of the services is present	0
Indicator evaluation for ESH	**30**

6.2.1.9b Service integration in building connected outdoor areas

Services that are the part of evaluation and influence the indicator performance are:

- Areas for sitting and/or lying down
- Flexible sheltering roofs
- Rain/snow protection
- Shading
- Protection against wind from the prevailing wind direction

Flexible sheltering roofs are not included in evaluation of this indicator.

Table 61: Evaluation of service integration

Service integration in building connected outdoor areas	Points
At least 4 of the 5 requirements are fulfilled in the outdoor area	100
3 of the 5 requirements are fulfilled in the outdoor area	75
2 of the 5 requirements are fulfilled in the outdoor area	50
1 of the 5 requirements is fulfilled in the outdoor area	25
None of the requirements is fulfilled in the outdoor area	0
Indicator evaluation for ESH	**75**

6.2.1.10 Public Accessibility

The public accessibility of a building promotes the communal life. Sub-indicators that evaluate the public accessibility are:

- General public access to the building
- External facilities open to the public
- Interior facilities, such as libraries or cafeteria, open to the public
- Possibility of third party to rent rooms in the building
- Variety of uses for public areas

6.2.1.10a General public access to the building

Table 62: Evaluation of general access

General public access to the building	Points
There is an intention to provide an access to the building for public	100
There is no plan for public access to the building	0
Indicator evaluation for ESH	**100**

6.2.1.10b External facilities open to the public

Table 63: Evaluation of external facilities

External facilities open to the public	Points
The outdoor facilities surrounding the building are accessible to the public	100
The outdoor facilities surrounding the building are not accessible to the public	0
Indicator evaluation for ESH	**100**

6.2.1.10c Interior facilities, such as libraries or cafeteria, open to the public

Table 64: Evaluation of interior facilities

Interior facilities, such as libraries or cafeteria, open to the public	**Points**
The building offers facilities open to the public	100
The building does not offer facilities open to the public	0
Indicator evaluation for ESH	**100**

6.2.1.10d Possibility of third party to rent rooms in the building

Table 65: Evaluation of renting possibilities

Possibility of third party to rent rooms in the building	**Points**
Third party can rent rooms in the building	100
Third party cannot rent rooms in the building	0
Indicator evaluation for ESH	**100**

6.2.1.10e Variety of uses for public areas

Table 66: Evaluation of variety of public areas

Variety of uses for public areas	**Points**
The rentable areas are available for a variety of uses that make them attractive for as many interested parties as possible (e.g: conferences, services, retail, etc.)	100
The rentable areas are not available for a variety of uses	0
Indicator evaluation for ESH	**100**

6.2.1.11 Noise from Building and Site

This indicator aims at calculating the likelihood of noise from the building and site affecting nearby noise-sensitive buildings. A noise impact assessment in compliance with ISO 1996 should be carried out and the following noise levels measured/determined.

Table 67: Evaluation of noise from building

Noise from building and site	Points
The specific noise level of the noise sources from the site/building is less than +5dB during the day (0700hrs to 2200hrs) and less than +3dB at night (2200hrs to 0700hrs) compared to the background noise level OR There are or will be no noise-sensitive areas or buildings in the locality of the assessed building	100
A noise impact assessment in compliance with ISO 1996 was carried and the specific noise level is lower than the maximum noise level accepted by national regulations.	10
A noise impact assessment in compliance with ISO 1996 was carried and the rating level of the noise sources from the site/building is greater than the background noise level	5
There was no noise impact assessment carried.	0
Indicator evaluation for ESH	**0**

6.2.1.12 Bicycle Amenities

Indicator evaluates bicycle infrastructure, such as bike parking in the public space inside or outside of a building. Bicycle comfort is evaluated by considering next sub indicators:

- Number of bicycle parking spaces available for building users
- Distance to bicycle parking system from a main building entrance
- Existence of facilities for bicycle comfort and security

ESH building has total of 133 m^2 of parking spaces available for building users located in the ground floor of the building. With predicted 310 users of the apartment building (standard area of 35 m2 per person). This area should be more than enough to store 31 bicycles, for the 10% of building users.

All the parking spaces are within the 15 m from the main entrance. All bicycle parking spaces are locked and for private use, so the security should be good

6.2.1.12a Number of bicycle parking spaces available for building users

Table 1: Evaluation of bicycle parking area

Number of bicycle parking spaces available for building users	Points
> 10% of the number of building users	100
> 7% of the number of building users	75
> 5% of the number of building users	50
> 3% of the number of building users	10
< 3% of the number of building users	0
Indicator evaluation for ESH	**100**

6.2.1.12b Distance to bicycle parking system from a main building entrance

Table 2 Evaluation of parking distance

Distance to bicycle parking system from a main building entrance	Points
< 15 m	100
< 30 m	75
< 50 m	50
< 70 m	25
< 100 m	10
> 100 m	0
Indicator evaluation for ESH	**100**

6.2.1.12c Existence of facilities for bicycle comfort and security

Table 3: Evaluation of bicycle security

Existence of facilities for bicycle comfort and security	Points
4 kinds of facility	100
3 kinds of facility	75
2 kinds of facility	50
1 kind of facility	25
0 kind of facility	10
Indicator evaluation for ESH	**100**

6.2.1.13 Material Sourcing: wood

The indicator aims at encouraging the specification of timber from sustainably managed sources. The assessment is conducted quantitatively using three different quality levels described and evaluated in table below. Quality level 3 was achieved for ESH.

Table 68: Material-sourcing evaluation

Material Sourcing: wood	**Points**
Quality level 1: It can be verified that documents from the planning stage and the call for tenders underlines the importance of ensuring that all wood products procured emanate from sustainably managed forests. FSC/PEFC certificates and corresponding CoC (Chain of Custody) certificates are at this level only required for wood products from tropical and subtropical timbers.	100
Quality level 2: At least 50% of all timber and wood products are produced by sustainable forestry. This is verified by an FSC/PEFC certificate and a corresponding CoC certificate. Quantification can be determined by a quantity estimate based on the component catalogue for the life cycle assessment (see indicator 3.1) or for each trade based on the calls for tenders.	50
Quality level 3: At least 80% of all timber and wood products are produced by sustainable forestry. This is verified by an FSC/PEFC certificate and a corresponding CoC certificate. Quantification can be determined by a quantity estimate based on the component catalogue for the life cycle assessment (see indicator 3.1) or for each trade based on the calls for tenders.	10
The Quality level 1 was not achieved.	0
Indicator evaluation for ESH	**10**

6.2.2 SCORING CARD FOR SOCIAL/FUNCTIONAL INDICATORS

Table 69: Scoring card for social and functional quality (All indicators assessed)

Social / Functional Quality							**79,6**
2.1	**Barrier-free Accessibility**						
2.1.1	Barrier-free Accessibility	100	1	**100**	**3,09**	**3,00%**	
2.2	Personal Safety and Security of Users						
2.2.1	The satisfaction of minimum health and safety requirements in the workplace	100	4	**100**	**2,84**	**2,76%**	
2.2.2	Reduction of the extent of damage if an accident should occur inside and outside the building	100	4				
2.2.3	Measures preventing building users from crime	100	2				
2.3	**Thermal Comfort**						
2.3.1	Operative temperature	75	4	**87,5**	**3,40**	**3,30%**	
2.3.2	Radiant temperature asymmetry and floor temperature	100	1				
2.3.3	Draught, air velocity	100	2				
2.3.4	Humidity in indoor air	100	1				
2.4	**Indoor Air Quality**						
2.4.1	Occupancy-based ventilation rates	100	4	**95**	**4,00**	**3,88%**	
2.4.2	Indoor air contamination with the most relevant indoor air pollutants (formaldehyde, naphtalene, toluene, xylene, styrene) [Existing buildings]	100	4				
2.4.3	CO2 concentration above outdoor level [Existing buildings]	100	4				
2.4.4	Subjective reaction as classification of the indoor air quality [Existing buildings]	100	4				
2.4.5	Occurrence of Radon	75	4				
2.5	Water Quality						
2.5.1	Constant Water Supply through the day	100	4	**66,667**	**3,26**	**3,16%**	
2.5.2	Use of alternative water supplies	100	4				
2.5.3	Water Disinfection	0	4				
2.6	**Acoustic Comfort**						
2.6.1	Indoor ambient noise levels in unoccupied staff/office areas	100	4	**100**	**2,39**	**2,32%**	
2.6.2	Reverberation period	100	4				

2.7	**Visual Comfort**			**88**	**2,54**	**2,46%**
2.7.1	Availability of daylight throughout the building	100	4			
2.7.2	Availability of daylight in regularly used work areas	100	4			
2.7.3	View to the outside	75	3			
2.7.4	Preventing glare in daylight	75	3			
2.7.5	Preventing glare in artificial light	100	3			
2.7.6	Light distribution in artificial lighting conditions	100	3			
2.7.7	Color rendering	50	3			
2.7.8	Blinking and flashing lights	100	2			
2.8	**Operation Comfort**			**100**	**2,36**	**2,29%**
2.8.1	Ventilation	100	3			
2.8.2	Shading	100	3			
2.8.3	Glare prevention	100	3			
2.8.4	Temperatures during the heating period	100	3			
2.8.5	Temperatures outside the heating period	100	3			
2.8.6	Regulation of daylight and artificial light	100	3			
2.8.7	Ease of operation	100	4			
2.9	Service Quality			**52,5**	**1,82**	**1,76%**
2.9.1	Availability of services in the building	30	4			
2.9.2	Service integration in building connected outdoor areas	75	4			
2.11	**Public Accessibility**			**100**	**2,04**	**1,98%**
2.11.1	General public access to the building	100	4			
2.11.2	External facilities open to the public	100	2			
2.11.3	Interior facilities, such as libraries or cafeteria, open to the public	100	2			
2.11.4	Possibility of third party to rent rooms in the building	100	2			
2.11.5	Variety of uses for public areas	100	4			
2.12	Noise from Building and Site			**0**	**1,85**	**1,79%**
2.12.1	Noise from Building and Site	0	4			
2.16	**Bicycle Amenities**			**100**	**2,24**	**2,17%**
2.16.1	Number of bicycle parking spaces available for building users	100	4			
2.16.2	Distance to bicycle parking system from a main building entrance	100	3			

2.16.3	Existence of facilities for bicycle comfort and security	100	3			
2.17	**Material Sourcing**					
2.17.1	Material Sourcing: Wood	10	4	**10**	**2,55**	**2,47%**

6.3 ECONOMIC QUALITY INDICATORS

Economic indicators for building considered and evaluated within OPEN HOUSE methodology are

- **Building-related Life Cycle Costs (LCC)**
- Value Stability

Core indicators are in bold.

6.3.1 EVALUATION OF ECONOMIC QUALITY INDICATORS

6.3.1.1 Building-related Life Cycle Costs (LCC)

The calculation of Life Cycle Costs (LCC) can be done following different available standards. For the LCC assessment of ESH, German DGNB methodology was implemented. Building related LCC are evaluated with two sub indicators:

- Life cycle costs
- Sensitivity analysis [design phase]

6.3.1.1a Life cycle costs

Evaluation of building-related life cycle costs takes into account different life cycle stages of building construction that were included in LCC analyse:

- Stage 1 Material and construction stage 30 points
- Stage 2a In use operational costs 5 points
- Stage 2b In use energy costs 20 points
- Stage 2c In use water costs 10 points
- Stage 3 Demolition costs 5 points

LCC analyse for ESH building was performed for all stages except Stage 3. Four out of five requirements have been met so 65 points out of 70 possible have been awarded from this section.

Table 70: Evaluation of LCC stages

Calculation completed for different life cycle stages	**Points**
Score achieved depending on the stages for which the calculation has been completed	0-70
Indicator evaluation for ESH	**65**

Second indicator takes into account the adaptation of the service life of products to the assessed building:

- Choice of products
- Maintenance characteristics
- Quality of construction
- Adaptation to indoor/outdoor conditions
- Users operation (training, …)

All five parameters are included in LCC analyse, so all 15 points available from second section was awarded.

Table 71: Evaluation of LCC parameters

Adaptation of the service life of products to the assessed building	**Points**
All of five requirements are fulfilled	15
Four out of five requirements are fulfilled	12
Three out of five requirements are fulfilled	9
Two out of five requirements are fulfilled	6
One out of five requirements is fulfilled	3
Indicator evaluation for ESH	**15**

Third indicator takes into account the type of data used for the assessment. Building specific data were used so all 15 points available from third section was awarded.

Table 72: Evaluation of data

Type of data used for the assessment	**Points**
Specific data	15
Generic data	5
Indicator evaluation for ESH	**15**

6.3.1.1b Sensitivity analysis [design phase]

The evaluation of this sub-indicator is based on the existence of a sensitivity analysis to check:

- Value stability for energy related to thermal comfort and variation of energy use
- Value stability for human costs
- Value stability for products

Sensitivity analyses was performed for all of above categories.

Table 73: Evaluation of sensitivity analysis

Sensitivity Analysis	**Points**
All three sensitivity analyses have been performed	100
Two out of three sensitivity analyses have been performed	75
One out of three sensitivity analyses has been performed	50
No sensitivity analysis has been performed	0
Indicator evaluation for ESH	**100**

6.3.1.2 Value Stability

The objective is to ensure a high flexibility for different user requirements and future developments. The assessment focuses on the building independently from the external economic situation. Main aspects of value stability are: building adaptability and flexibility, resources dependency and building performance management.

- Area efficiency
- Conversion feasibility
- Energy and water dependency
- Building performance management

6.3.1.2a Area efficiency

Evaluation of this sub indicator is based on space efficiency factor (Seff). Space efficiency factor is determined as:

Seff = UA (of all floor levels) / TFA

UA - Usable area in m^2: ESH 10002 m^2 (apartment area is used for this factor)

TFA - Total floor area in m^2: ESH 12800 m^2 (total heated area is used for this factor)

Seff for ESH: 0,78

Table 74: Evaluation of area efficiency

Area Efficiency	Points
Seff ≥ 0,75	100
Seff ≥ 0,72	90
Seff ≥ 0,69	80
Seff ≥ 0,66	70
Seff ≥ 0,63	60
Seff ≥ 0,60	50
Seff ≥ 0,56	40
Seff ≥ 0,52	30
Seff ≥ 0,48	20
Seff ≥ 0,44	10
Seff < 0,44	0
Indicator evaluation for ESH	**100**

6.3.1.2b Conversion feasibility

The conversion feasibility is evaluated with the following requirements:

- Building modularity
- Spatial structure
- Power and media supply
- Heating and water supply/disposal

Building modularity is based on the indoor clearance height. Indoor clearance high of ESH is 2,6 m

Table 75: Evaluation of modularity

Building modularity	**Points**
indoor height clearance > 2,75 m	25
indoor height clearance > 2,50 m	5
indoor height clearance < 2,50 m	0
Indicator evaluation for ESH	**5**

Spatial structure is based on the feasibility of different room-separating elements to be added removed, changed, safely stoored etc.

Table 76: Evaluation of spatial structure first part

Spatial structure 1	**Points**
Non-load transferring, room-separating elements can be added to, converted, or removed without too much effort and with uninterrupted building operation.	15
Non-load transferring, room-separating elements can be added to, converted, or removed without too much effort and with limited influence on building operation.	10
Non-load transferring, room-separating elements can be added to, converted, or removed without too much effort, but highly influence building operation.	5
Non-load transferring, room-separating elements cannot be added to, converted, or removed without too much effort.	0
Indicator evaluation for ESH	**0**

Table 77: Evaluation of spatial structure second part

Spatial structure 2	**Points**
Non-load transferring, room-separating elements can be dismantled and it is possible to store temporarily unnecessary elements.	10
Non-load transferring, room-separating elements cannot be dismantled and unnecessary elements cannot be stored temporarily.	0
Indicator evaluation for ESH	**0**

Power and media supply is based on the three following characteristics:

- Power and media conduits run to easily accessible supply shafts, cable ducts, or false floors and/or visibility of these lines
- Utilization of less than 80 % of the capacity of the supply shafts and ductwork for power and media conduits,
- Electric installation/building automation realized using a BUS system.

Table 78: Evaluation of power and media supply

Power and media supply	Points
All three characteristics are fulfilled	25
Two of three characteristics are fulfilled	15
One of the three characteristics is fulfilled	5
None of the three characteristics is fulfilled	0
Indicator evaluation for ESH	**25**

The total value for conversion feasibility of ESH is the sum of above four indicators (30).

6.3.1.2c Energy and water dependency

Energy and water dependency is based on the scores of two indicators. Indicator 1.11 Water and Waste Water from Environmental Quality indicators evaluated before and indicator 4.6 Building shell as a part of Technical Characteristics indicator.

Score for indicator 1.11 Water and Waste Water is (50 points).

Score for indicator 4.6 Building shell is (100 points), description of evaluation below.

Overall score for Energy and water dependency indicator is 75 according to OPEN HOUSE.

Table 79: Evaluation of energy and water dependency

Heating and water supply/disposal	Points
If the score of both indicators is higher than 50 points, the achieved score is the average of the score of both indicators.	50-100
If the score of one indicator is lower than 50 points, the achieved score is the average of the score of both indicators, but cannot exceed 50 points.	10-50
If the score of one indicator is lower than 10 points, the achieved score is the average of the score of both indicators, but cannot exceed 10 points.	0-10
Indicator evaluation for ESH	**75**

6.3.1.2d Building performance management

The optimization of the performance of a building during its operation is essential to maintain the value of the building, because reducing running costs and improving its environmental performance. The evaluation is based on the score achieved by indicators 4.3 Cleaning and Maintenance part of Technical Characteristics indicators and indicator 5.9 Handover and Performance Evaluation as a part of Process Quality indicators.

Score for indicator 4.3 Cleaning and Maintenance (48,33 points), description of evaluation below in Technical characteristics section.

Score for indicator 5.9 Handover and Performance Evaluation (88 points), description of evaluation below in process quality section.

Overall score for Energy and water dependency indicator is 50 according to OPEN HOUSE.

Table 80: Evaluation of performance management

Building performance management	Points
If the score of both indicators is higher than 50 points, the achieved score is the average of the score of both indicators.	50-100
If the score of one indicator is lower than 50 points, the achieved score is the average of the score of both indicators, but cannot exceed 50 points.	10-50
If the score of one indicator is lower than 10 points, the achieved score is the average of the score of both indicators, but cannot exceed 10 points.	0-10
Indicator evaluation for ESH	**50**

6.3.2 SCORING CARD FOR ECONOMIC INDICATORS

Table 81: Scoring card for economic quality of ESH (All indicators assessed)

Economic Quality							**77,9**
3.1 Building-related Life Cycle Costs (LCC)							
3.1.1	Life cycle costs	95	4	**97,143**	**4,00**	**17,87%**	
3.1.3	Sensitivity analysis [design phase]	100	3				
3.2 Value Stability							
3.2.1	Area Efficiency	100	2	**56**	**3,46**	**15,47%**	
3.2.2	Conversion feasibility	30	4				
3.2.3	Energy and water dependency	75	1				
3.2.4	Building performance management	50	1				

6.4 TECHNICAL CHARACTERISTICS INDICATORS

Technical characteristics assessment include:

- Cleaning and maintenance
- Noise Protection
- **Quality of the building shell**
- **Ease of Deconstruction, Recycling, and Dismantling**

Core indicators are marked in bold. Both core indicators were assessed for ESH building. Additionally also Cleaning and maintenance indicator was assessed, since this indicator indirectly influences the result of Economic quality category through sub indicator 3.2.4 Building performance management.

Quality of building shell is one of core indicators in this section and it has also indirect effect on Economic quality category through sub indicator 3.2.3 Energy and water dependency.

Result of technical characteristics indicators are not the part of overall building result that takes into account only environmental quality, social/functional quality and economic quality of building. They can be evaluated separately.

6.4.1 EVALUATION OF TECHNICAL CHARACTERISTICS INDICATORS

6.4.1.1 Cleaning and Maintenance

Indicator 4.3 Cleaning and Maintenance evaluates ease of cleaning and maintenance of different the structures of building:

- Load-bearing structure (50 points)
- Non-load-bearing external structures, including windows and external doors (50 points)
- Non-load-bearing interior structures (45 points)

6.4.1.1a Load-bearing structure

Table 82: Evaluation of load bearing construction

Load-bearing structure – primary structure	**Points**
Parts of the primary structure relevant to maintenance are easily accessible for maintenance operations.	100
Parts of the primary structure relevant to maintenance are accessible for maintenance operations, after removing the attachment components.	50
Parts of the primary structure relevant to maintenance are accessible for maintenance operations, after difficult dismantling.	10
Parts of the primary structure relevant to maintenance are not accessible for maintenance operations.	0
Indicator evaluation for ESH	**50**

6.4.1.1b Non-load-bearing external structures

Table 83: Evaluation of glass surfaces

Non-load-bearing external structures – glass surfaces	Points
100% of the external glass surfaces are easily accessible. The upper edge of the floor to the upper edge of the glass surface = 2.5 m	100
More than 90% of the external glass surfaces are easily accessible. The upper edge of the floor to the upper edge of the glass surface = 2.5 m	50
Less than 90% of the external glass surfaces are easily accessible. The upper edge of the floor to the upper edge of the glass surface = 2.5 m. For the rest of the external glass surfaces, there are permanent cleaning catwalks or ladders installed.	10
More than 10% of the external glass surface is not easily accessible (basket cranes, climbing belts etc. are needed)	0
Indicator evaluation for ESH	**50**

6.4.1.1c Non-load-bearing interior structures

Non-load-bearing interior structures indicator consists of four further sub indicators. Score for this indicator is the sum of all four sub indicators is 45 points.

Table 84: Evaluation, non-load bearing internal structure - flooring

4.3.3.a Non-load-bearing interior structures - flooring	Points
All of the trafficked area and more than 80% of the floor space is tolerant of light soiling (patterned, mottled or structured)	25
Only the trafficked area is tolerant of light soiling (patterned, mottled or structured)	10
No area is tolerant of light soiling (not patterned, mottled or structured)	0
Indicator evaluation for ESH	**25**

Table 85: Evaluation, non-load bearing internal structure – dirt-catching zone

4.3.3.b Non-load-bearing interior structures – dirt-catching zone	Points
In front of every entrance is an adequate dirt-catching zone of at least 4 m	25
In front of every entrance is an adequate dirt-catching zone of at least 2 m	10
No adequate dirt-catching zone	0
Indicator evaluation for ESH	**10**

Table 86: Evaluation, non-load bearing internal structure – baseboards

4.3.3.c Non-load-bearing interior structures – baseboards	**Points**
All baseboards are mechanically secured to ensure constant protection against floor cleaning.	25
Baseboards are not mechanically secured	0
Indicator evaluation for ESH	**0**

Table 87: Evaluation, non-load bearing internal structure – obstacles

4.3.3.d Non-load-bearing interior structures - obstacles	**Points**
There are no inaccessible niches, empty spaces, dead angles, corners and columns in hallways and rooms	25
There are some inaccessible niches, empty spaces, dead angles, corners and columns in hallways and rooms	10
There are many inaccessible niches, empty spaces, dead angles, corners and columns in hallways and rooms	0
Indicator evaluation for ESH	**10**

6.4.1.2 Quality of the building shell

Indicator 4.6 Quality of the building shell takes into account technical characteristics of building that effect heating and cooling demand, ensuring a high thermal comfort and avoiding structural damages. Quality of the building shell is evaluated through six sub indicators:

- Median thermal transmittance coefficients of building components Ū
- Thermal Bridges
- Air permeability class (window air-tightness)
- Amount of condensation inside the structure
- Air exchange n50 and if necessary q50
- Solar heat protection

This indicator influences Economic quality category through sub indicator 3.2.3 Energy and water dependency.

Table 88: Thermal envelope ESH and Reference building

Thermal envelope	ESH building		Reference building (PURES)	
	Average U - value [W/(m²K)]	Area (m²)	Average U - value [W/(m²K)]	Area (m²)
North Windows	0,852	403,5	1,310	403,5
East Windows	0,807	713,9	1,290	713,9
South Windows	0,842	950,1	1,299	950,1
West Windows	0,826	1085,0	1,274	1085,0
Exterior Wall - Ambient	0,166	4716,4	0,221	4716,4
Roof/Ceiling - Ambient	0,140	1976,1	0,140	1976,1
Installation shafts	0,214	782,0	0,214	782,0
Floors above unheated space	0,941	935,5	0,941	935,5

6.4.1.2a Median thermal transmittance coefficients of building components $\bar{U}$

Table 89: Evaluation of average thermal transmittance

Average thermal transmittance coefficients of building components $\bar{U}$		**Points**
Target values of specific country = approximately standard value – 40 %, e.g. components for Germany:	e.g. values for Germany:	
1. Opaque external building components (not included in components of 3. and 4.)	< 0,20	100
2. Transparent external building components (not included in components of 3. and 4.)	< 1,30	
3. Curtain facade	< 1,40	
4. Glass roofs, rows of windows, skylights	< 2,20	
Target values of specific country = approximately standard value – 20 %, e.g. components for Germany:	e.g. values for Germany:	
1. Opaque external building components (not included in components of 3. and 4.)	< 0,28	50
2. Transparent external building components (not included in components of 3. and 4.)	< 1,50	
3. Curtain facade	< 1,50	
4. Glass roofs, rows of windows, skylights	< 2,60	
Standard values of specific country, e.g. components for Germany:	e.g. values for Germany:	
1. Opaque external building components (not included in components of 3. and 4.)	< 0,35	10
2. Transparent external building components (not included in components of 3. and 4.)	< 1,90	
3. Curtain facade	< 1,90	
4. Glass roofs, rows of windows, skylights	< 3,10	
Higher values		0
Indicator evaluation for ESH		**100**

6.4.1.2b Thermal Bridges

Table 90: Evaluation of thermal bridges

Thermal Bridges	Points
Detailed calculations in accordance with EN ISO 10211: Thermal bridge adjustment < 0,01 W/m²K	100
Compliance in accordance with EN ISO 13788: Thermal bridge adjustment < 0,05 W/m²K	50
Information related to the existing thermal bridges is available: Thermal bridge adjustment < 0,10 W/m²K	10
No information related to the existing thermal bridges is available.	0
Indicator evaluation for ESH	**100**

6.4.1.2c Air permeability class (window air-tightness)

Table 91: Evaluation of windows air permeability class

Air permeability class (window air-tightness)	Points
Air permeability (interstitial air-tightness): Class 4	100
Air permeability (interstitial air-tightness): Class 3	70
Air permeability (interstitial air-tightness): Class 2	40
Air permeability (interstitial air-tightness): Class 1	10
No compliance with one of the Classes.	0
Indicator evaluation for ESH	**100**

6.4.1.2d Amount of condensation inside the structure

Table 92: Evaluation of condensation in structure

Amount of condensation inside the structure	Points
Approval in accordance with EN ISO 13788 or transient heat and humidity determination process EN 15026.	100
No approval	0
Indicator evaluation for ESH	**100**

6.4.1.2e Air exchange n50 and if necessary q50

Table 93: Evaluation of air exchange rate n50

Air exchange n50 and if necessary q50		**Points**
Buildings with an interior volume ≤ 1500 m³		100
without ventilation systems: Air exchange rate n50 in h-1	1,0	
with ventilation systems: Air exchange rate n50 in h-1	0,8	
in addition, for buildings with an interior volume > 1500 m³		
Air exchange with respect to external surface area q50	2,0	
Buildings with an interior volume ≤ 1500 m³		50
without ventilation systems: Air exchange rate n50 in h-1	1,5	
with ventilation systems: Air exchange rate n50 in h-1	1,0	
in addition, for buildings with an interior volume > 1500 m³		
Air exchange with respect to external surface area q50	2,5	
Buildings with an interior volume ≤ 1500 m³		10
without ventilation systems: Air exchange rate n50 in h-1	3,0	
with ventilation systems: Air exchange rate n50 in h-1	1,5	
in addition, for buildings with an interior volume > 1500 m³		
Air exchange with respect to external surface area q50	3,0	
No compliance.		0
Indicator evaluation for ESH		**100**

Blower door tests were performed of entire building was performed partially on smaller sectors with individual volumes less than 1500 m³.

6.4.1.2f Solar heat protection

Table 94: Evaluation of solar heat protection

Solar heat protection	**Points**
Solar heating protection SHP ≤ 0,12	100
Solar heating protection SHP ≤ 0,16	10
Solar heating protection SHP > 0,16	0
Indicator evaluation for ESH	**100**

6.4.1.3 Ease of Deconstruction, Recycling, and Dismantling

Goal of increasing the ease of deconstruction, recycling, and dismantling is the avoidance of waste, in particular by reducing its amount and hazard. Indicator is evaluated through six sub indicators:

- Effort for dismantling /disassembly
- Effort for sorting/separation
- Verification of the inclusion of a recycling/disposal concept with information about construction components in the certification application

6.4.1.3a Effort for dismantling/disassembly

Tabell 95: Evaluation of disassembly

4.7.1 Effort for dismantling /disassembly	**Points**
Disassembly requires very low effort: e. g. clamped joints, loose supports, simple snapping or bolted joints	100
Disassembly requires low effort: e. g. removal of filler material, removal of bolted clamps	75
Disassembly requires moderate effort: e. g. tearing up flooring, removal of poured sheathing elements	50
Disassembly requires high effort: e. g. demolition of adhesive coatings	5
Disassembly requires very high effort:	0
Indicator evaluation for ESH	**50**

6.4.1.3b Effort for sorting/separation

Tabell 96: Evaluation of sorting

4.7.2 Effort for sorting/separation	**Points**
Low effort for sorting/separating	100
Reasonable effort for sorting/separating	10
High effort for sorting/separating	0
Indicator evaluation for ESH	**10**

6.4.1.3c Verification of the inclusion of a recycling/disposal concept with information about construction components in the certification application

Table 97: Evaluation of inclusion

4.7.3 Verification of the inclusion of a recycling/disposal concept with information about construction components	Points
A verifiable recycling/disposal plan dealing with the end of life for major building components is prepared	100
A verifiable recycling/disposal concept is prepared	50
A verifiable recycling/disposal concept is NOT prepared	0
Indicator evaluation for ESH	**50**

6.4.2 SCORING CARD FOR TECHNICAL CHARACTERISTICS INDICATORS

Table 98: Scoring card for technical characteristics (Core indicators)

Technical Characteristics					
4.3	Cleaning and maintenance				
4.3.1	Load-bearing structure	50	4	**48,33**	**4,00**
4.3.2	Non-load-bearing external structures	50	4		
4.3.3	Non-load-bearing interior structures	45	4	**100,00**	**2,97**
4.6	**Quality of the building shell**				
4.6.1	Median thermal transmittance coefficients of building components Ū	100	3	**100,00**	**3,53**
4.6.2	Thermal Bridges	100	1		
4.6.3	Air permeability class (window air-tightness)	100	3		
4.6.4	Amount of condensation inside the structure	100	2		
4.6.5	Air exchange n_{50} and if necessary q_{50}	100	1		
4.6.6	Solar heat protection	100	1		
4.7	**Ease of Deconstruction, Recycling, and Dismantling**				
4.7.1	Effort for dismantling /disassembly – divided into 5 steps	50	4	**36,67**	**3,61**
4.7.2	Effort for sorting/separation – divided into 3 steps	10	4		
4.7.3	Verification of the inclusion of a recycling/disposal concept with information about construction components in the certification application	50	4		

6.5 PROCESS QUALITY INDICATORS

Process quality assessment include:

- **Project Briefing Strategy**
- Integral Planning
- Building Performance Targets
- Evidence of Sustainability during Bid Invitation and Awarding
- **Construction Site impact/ Construction Process**
- Quality of the Executing Contractors/Pre-Qualification
- Quality Assurance of Construction Execution
- **Commissioning**
- Handover and Performance Evaluation

Core indicators are marked in bold. All core indicators were assessed for ESH building. Additionally also Handover and Performance Evaluation indicator was assessed, since this indicator indirectly influences the result of Economic quality category through sub indicator 3.2.4 Building performance management. Result of process quality indicators are not the part of overall building result that takes into account only environmental quality, social/functional quality and economic quality of building. Assessment is done separately.

6.5.1 EVALUATION OF PROCESS QUALITY INDICATORS

6.5.1.1 Project Briefing Strategy

Sustainability of buildings starts in the early planning phases and this indicator encourages the consideration of sustainability issues during the preparation and planning of the project. Sub indicators included:

- Project Brief
- Architectural competition

6.5.1.1a Project Brief

Table 99: Evaluation of project

5.1.1 Project Brief	**Points**
A comprehensive brief was agreed in detail to outline building owner's needs in line with Appendix 1 of this criterion, or of similar scope. This may be in the form of a report, which states the project's intended approach, and the guidelines and strategies which the design and construction teams will seek to implement in design.	100
No design brief nor demand description or something comparable was conducted or can be evidenced.	0
Indicator evaluation for ESH	**100**

6.5.1.1b Architectural competition

There was no architectural coopetition for ESH project.

Table 100: Evaluation of architectural competition

5.1.2 Architectural competition	**Points**
An architectural competition or other similar competition is prepared and takes place with special consideration of sustainable building. The jurors who award contracts and other experts (multidisciplinary) have experience in sustainable building. The sustainability of the design is a substantial part of the score of the competition entries (>40%).	100
No architectural competition or other similar competition is prepared and takes place with special consideration of sustainable building and/or no juror or other expert awarding the contract has experience in sustainable building	0
Indicator evaluation for ESH	**0**

6.5.1.2 Construction Site impact/ Construction Process

The effects of the construction site on the environment are to be minimized while simultaneously protecting the health of all participants. Sub indicators included:

- Low-waste and recycling on construction site
- Low-noise construction site
- Low-dust construction site
- Environmental protection at the construction site

6.5.1.2a Low-waste and recycling on construction site

Table 101: Evaluation of low waste and recycling during construction

5.5.1 Low-waste and recycling on construction site	**Points**
The minimum legal requirements in the national regulation were met - Furthermore, the people involved in the construction process were specifically trained in waste prevention. - The construction overseers ensured that material was separated and the various waste containers were used properly. - Construction materials were sorted into mineral waste, recyclable material, mixed construction waste, problematic substances, and waste containing asbestos.B15	100
The minimum legal requirements in the national regulation were met. - Construction materials were sorted into mineral waste, recyclable material, mixed construction waste, problematic substances, and waste containing asbestos.	50
No special steps were taken to prevent, reuse, or properly dispose of waste.	0
Indicator evaluation for ESH	**100**

6.5.1.2b Low-noise construction site

Table 102: Evaluation of noise during construction

5.5.2 Low-noise construction site	Points
The noise caused during construction must demonstrably and consistently be below the general noise level of the surroundings or it must be proven that the specifications in the call for tenders and bids were complied with. Measurements were conducted and documented to prove compliance.	100
The noise caused during construction must demonstrably and consistently be below the general noise level of the surroundings or it must be proven that the specifications in the call for tenders and bids were complied with. Compliance was checked and documented (test of low-noise construction equipment, compliance with protection times, etc.).	50
The call for tenders and bid documents specify the requirements for noise protection within the legal framework.	10
No special steps were taken to prevent construction noise. The national regulation about noise pollution was not complied with.	0
Indicator evaluation for ESH	**10**

6.5.1.2c Low-dust construction site

Table 103: Evaluation of dust during construction

5.5.3 Low-dust construction site	Points
All these specifications were required in the call of tenders and included in the bid. Their enforcement is monitored and documented.	100
All these specifications were required in the call of tenders and included in the bid.	50
Nothing was prepared to prevent or reduce dust	0
Indicator evaluation for ESH	**0**

6.5.1.2d Environmental protection at the construction site

Table 104: Evaluation of environmental protection during construction

5.5.4 Environmental protection at the construction site	**Points**
The documents for the call for tenders and bids expressly take account of environmental protection. Steps are taken to ensure that trees, water and soil are protected from chemical contamination, especially from the substances listed in the Risk and Safety Statements, or detrimental mechanical influence. Documentation from the construction management confirms environmental protection during the construction phase.	100
The documents for the call for tenders and bids expressly take account of environmental protection. Steps are taken to ensure that trees, water and soil are protected from chemical contamination, especially from the substances listed in the Risk and Safety Statements. Documentation from the construction management confirms environmental protection during the construction phase.	50
The documents for the call for tenders and bids expressly take account of environmental protection. Steps are taken to ensure that trees, water and soil are protected in accordance with national regulations.	10
No special actions are taken to protect the environment during construction phase.	0
Indicator evaluation for ESH	**0**

6.5.1.3 Commissioning

The basic purpose of building commissioning is to provide a quality-based process with documented confirmation that building systems in compliance with the building performance requirements.

Table 105: Evaluation of commissioning

5.8.1 Commissioning process management and documentation	Points
The commissioning outcome documents (progress reports, minutes of the meeting, check lists, statements) clearly demonstrate that the commissioning activities - defined in plan and commissioning programme - have been implemented according to commissioning specifications, methods and procedures (consistency between process and process out coming documents). Commissioning plan, programme and other documents have been regularly and systematically updated and integrated with the overall project schedule.	100
Commissioning with subsequent adjustments and operational optimization was conducted or contractually agreed upon within the first 14 months of use. Complete documentation is available or contractually agreed upon.	75
All system components were subjected to a functional test by the contractors who installed them. The type, scope, and results of these functional tests are documented in the handover logs.	50
Documentation why commissioning for all system components have not been conducted with plausible reasons. Functional tests for individual facility components have been conducted	10
No Commissioning was conducted, nor were functional tests for individual facility components.	0
Indicator evaluation for ESH	**100**

6.5.1.4 Handover and Performance Evaluation

Indicator 5.9 Handover and Performance Evaluation aims to cover many objectives. It encourages to handover the building to the users and managers in a way that helps them operate and manage the building efficiently. This indicator influences the result of Economic quality through indicator 3.2.4 Building performance management. Sub-indicators addressed are:

- 5.9.1 Handover & Documentation (100 points)
- 5.9.2 Building Performance Improvement (75 points)

6.5.1.4a Handover & Documentation

Handover and documentation sub indicator is a total sum four further sub indicators.

Table 106: Evaluation of trainings

5.9.1.a. Induction and Training	**Points**
Training on operating the building efficiently is given to BOTH technical staff (facilities managers) and non-technical end users, covering all environmental strategies (lighting, ventilation, heating and cooling)	25
No project documentation is compiled.	0
Indicator evaluation for ESH	**25**

Table 107: Evaluation of user manual non-technical

5.9.1.b. End User manual (non-technical)	**Points**
A plain-language, illustrated user manual is compiled, including recommendations and information for users to minimize ecological footprint, covering all environmental strategies (lighting, ventilation, heating and cooling)	25
No manuals for facility managers nor users is compiled.	0
Indicator evaluation for ESH	**25**

Table 108: Evaluation of technical manuals

5.9.1.c. Operation and Maintenance Manuals (technical)	**Points**
Detailed instructions for maintenance, inspection, operation, and care are compiled and a maintenance and repairs plan was drawn up; these instructions are specified for individual target groups (facility manager, building services engineer, cleaners, security, etc.).	25
No technical instructions for use, maintenance, and care are compiled.	0
Indicator evaluation for ESH	**25**

Table 109: Evaluation of technical documentation

5.9.1.d. As-built drawings	Points
Plans for the building are updated and prepared for use by facility managers; like the evidence documentation and calculations, the plans correspond to the finished building. In particular, the national energy performance certificate was adjusted to reflect reality.	25
The plans do not correspond to the finished building.	0
Indicator evaluation for ESH	**25**

6.5.1.4b Building Performance Improvement

Building Performance Improvement indicator sub indicator is a total sum three further sub indicators.

Table 110: Evaluation of continuous operation improvements

5.9.2a Evidence of continuous improvement in operation	Points
The building has can evidence a reduction in energy and water consumption, and waste production over the first three years.	50
The building has can evidence a reduction in EITHER energy consumption, OR water consumption, OR waste production over the first three years.	25
No reduction in energy and water consumption, and waste production can be evidenced	0
Indicator evaluation for ESH	**50**

Table 111: Evaluation of environmental certification achievements

5.9.2b Environmental Certification	Points
The building has achieved both ISO50001 and ISO14001	25
The building has achieved either ISO50001 or ISO14001	10
No Environmental or energy management certification has been achieved	0
Indicator evaluation for ESH	**0**

Table 112: Evaluation of design and delivery

5.9.2c Feedback Improving design and delivery	Points
At least three organisations from the delivery team (architect, consultants, builders, subcontractors or client) can demonstrate that feedback from monitoring and evaluation has been communicated to their staff	25
Less than three organisations can evidence that feedback from monitoring has been communicated to their staff.	0
Indicator evaluation for ESH	**25**

6.5.2 SCORING CARD FOR PROCES QUALITY INDICATORS

Table 113: Scoring card for process quality indicators (Core indicators)

Process Quality					
5.1	**Project Brief Strategy**			**75,00**	**4,00**
5.1.1	Project Brief	100	3		
5.1.2	Architectural competition	0	1		
5.5	**Construction Site impact/ Construction Process**			**27,50**	**3,15**
5.5.1	Low-waste and recycling on construction site	100	4		
5.5.2	Low-noise construction site	10	4		
5.5.3	Low-dust construction site	0	4		
5.5.4	Environmental protection at the construction site	0	4		
5.8	**Commissioning**				
5.8.1	Commissioning process management and documentation	100	4	**100,00**	**3,84**
5.9	Handover and Performance Evaluation			**87,50**	**3,93**
5.9.1	Handover & Documentation	100	4		
5.9.2	Building Performance Improvement	75	4		

6.6 LOCATION INDICATORS

Location quality indicators are not the part of overall building performance that takes into account only environmental quality, social/functional quality and economic quality of building.

Location quality indicators are assessed separately and therefore providing independent results. Location quality of building site according to OPEN HOUSE is defined by potential risks at the site, different circumstances at the site (outdoor air quality, noise levels, soil contamination,..), transportation options and proximity to different amenities (sports facilities, medical care, education,…). Indicators assessing location quality are:

- **Risks at the Site**
- Circumstances at the Site
- **Options for Transportation**
- Access to amenities

Core indicators are marked in bold. Both core indicators were evaluated for ESH building.

6.6.1 EVALUATION OF LOCATION QUALITY INDICATORS

6.6.1.1 Indicator 6.1 Risks at the Site

Objective of this indicator is to avoid development of buildings, roads, parking areas in risky areas. Risks on the site are defined with three different categories that include ground and climate conditions of the building site and potential man made hazards.

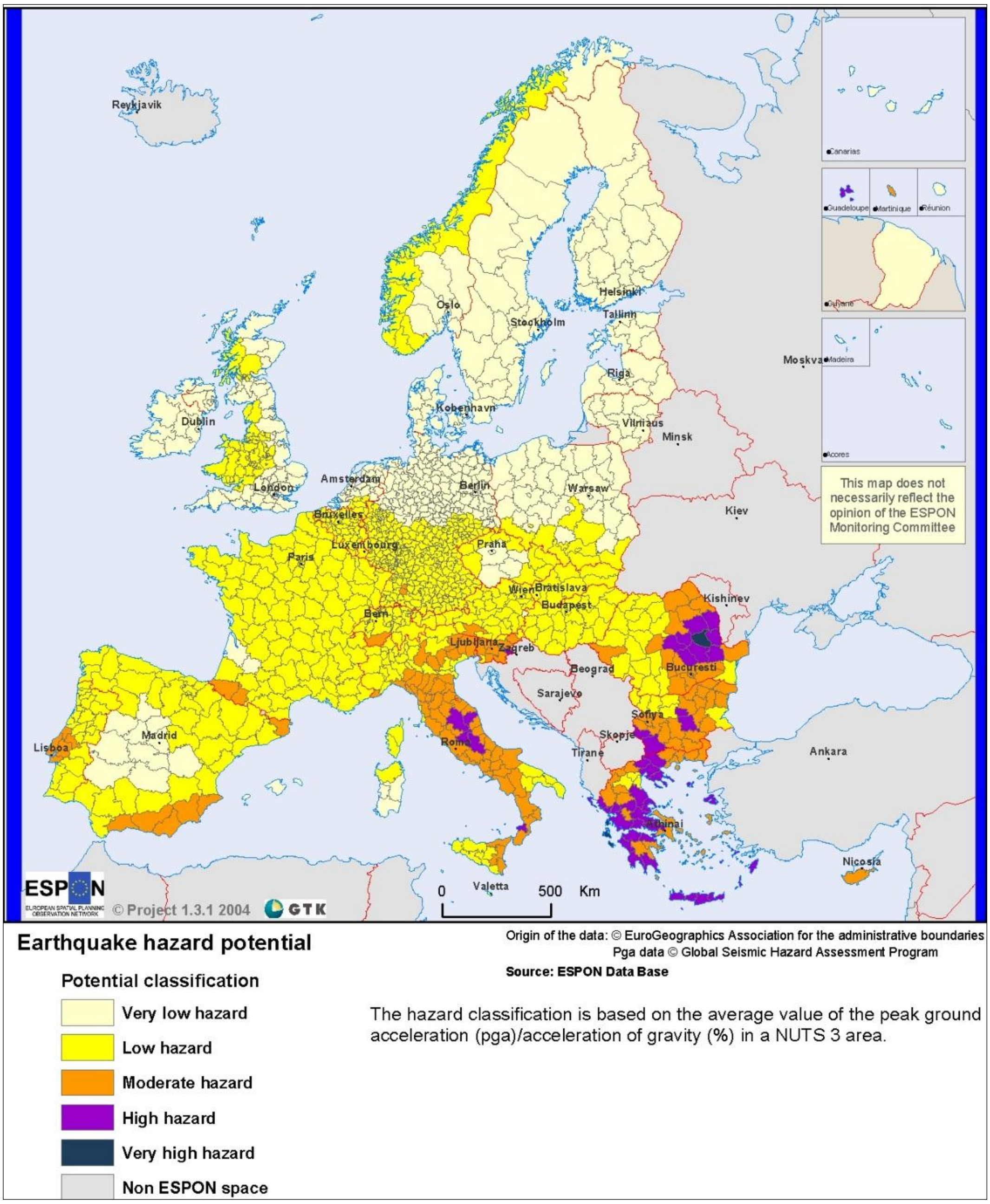
Sub indicators addressed:

- Ground, geology, seismology, volcanism: Earthquakes, Landslides, Volcanic eruptions; Tsunamis
- Weather/climate: Extreme temperatures, Forest fires, Drought, Floods, Storms, Avalanches)
- Man-made-hazards: Technological hazard/Chemical plants accidents, Technological hazard/Contaminant release and explosions, Technological hazard/Radioactive contamination from nuclear power plants accidents

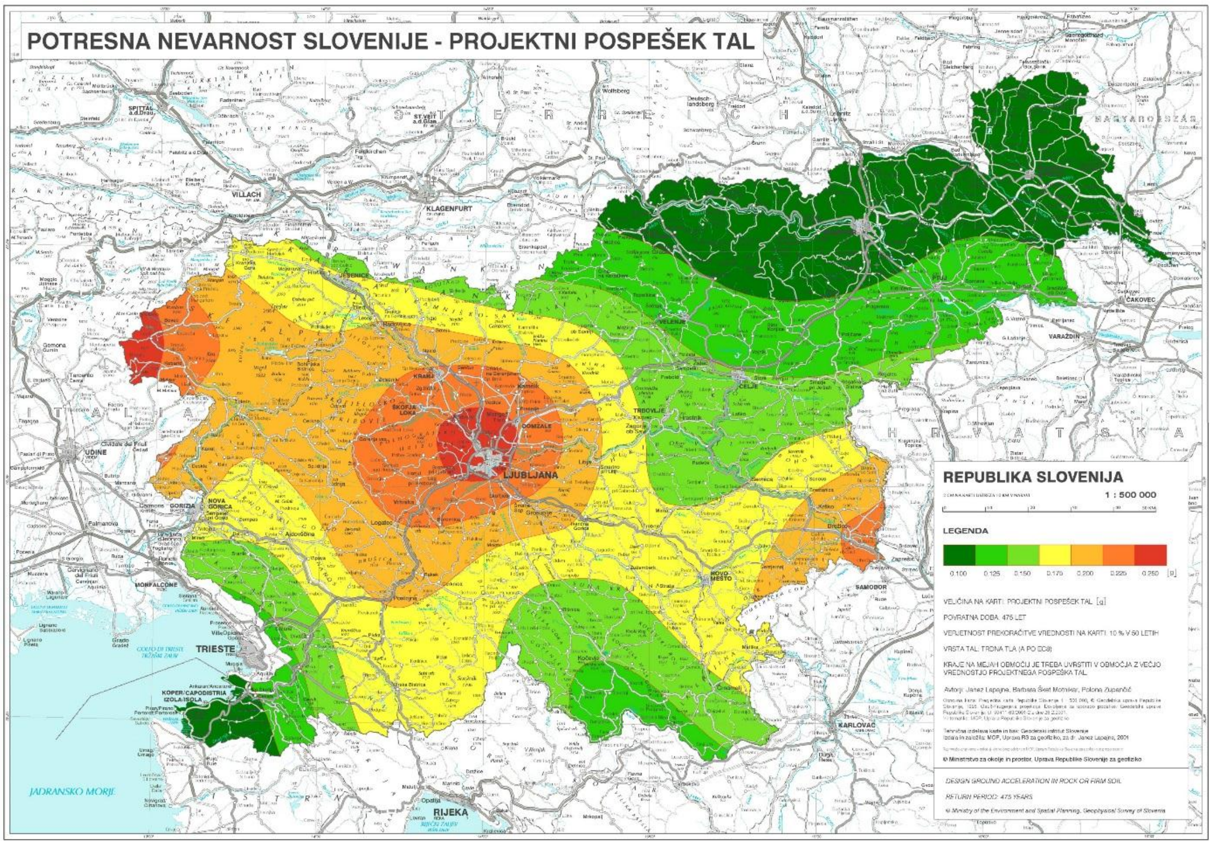
Different sub indicators were assessed using national data libraries, when reliable and precise data was available. Generally, indicators are evaluated by using existing hazards and risk maps, results of the European Spatial Planning Observation Network (ESPON 2006), project 1.3.1. “The spatial effects and management of natural and technological hazards in general and in relation to climate change”

6.6.1.1a Risk of Earthquakes

Risk of earthquakes was assessed using ESPON Earthquake hazard potential map and Slovenian national design peak ground acceleration map. Since the Slovenia lies in the region of Europe, where moderate level of hazard is predicted, and Ljubljana is in the area with higher peak ground acceleration for Slovenia, therefore the moderate level of hazard was chosen for this indicator.



Picture 27: Earthquake hazard potential (Source: ESPON)



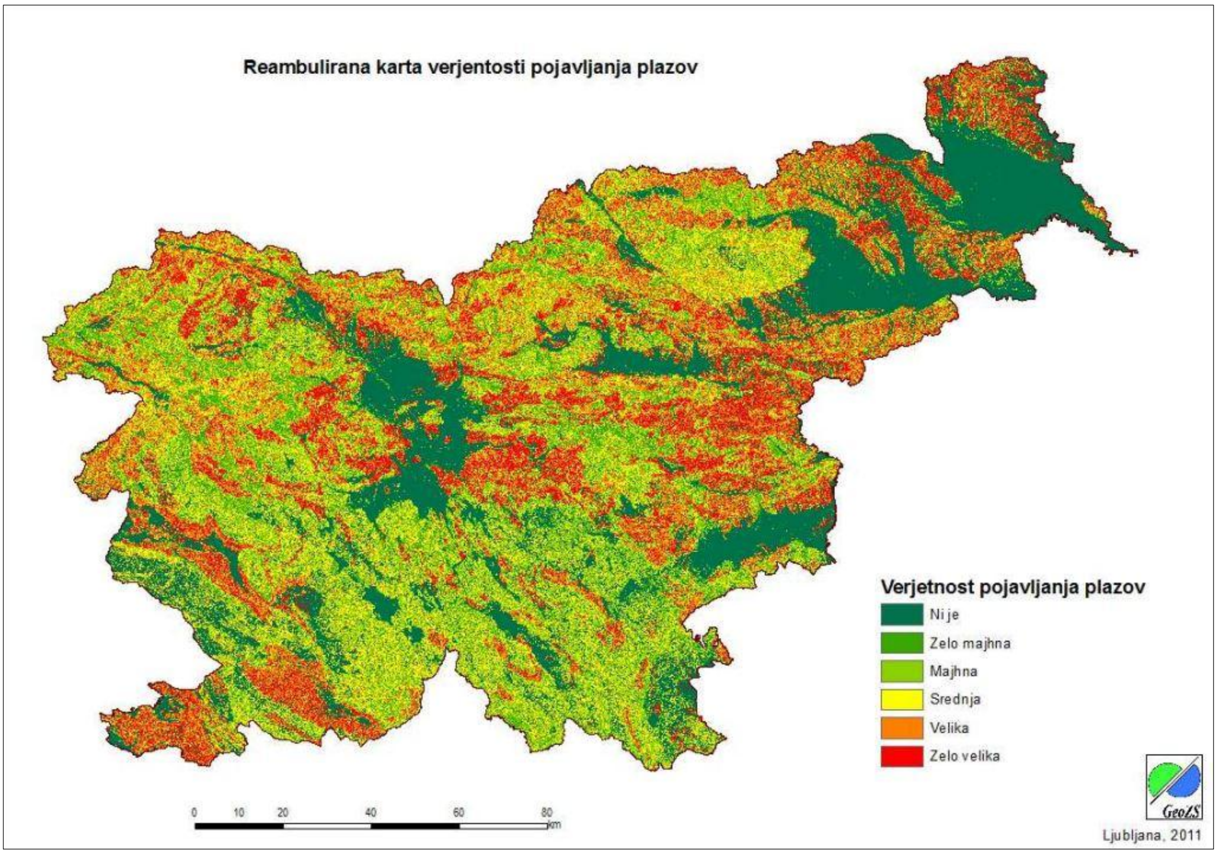
Picture 28: Design peak ground acceleration, Slovenia (Source: Slovenian Environment Agency – ARSO)

Table 114: Evaluation of risk of earthquakes

6.1.1 Risk of earthquake	**Points**
Very low hazard	100
Low Hazard	75
Moderate Hazard	50
High Hazard	5
Very high Hazard	0
Indicator evaluation for ESH	**50**

6.6.1.1b Risk of Landslides

There are no risks of landslides in the location of ESH.



Picture 29: Probability of landslide occurrence, Slovenia (Source: Geological Survey of Slovenia – GeoZS)

Table 115: Evaluation of landslides hazard

6.1.2. Risk of landslides	Points
Low hazard	100
High hazard	0
Indicator evaluation for ESH	**100**

6.6.1.1c Risk of volcanic eruptions

There are no risks regarding volcano eruptions in Slovenia.

Table 116: Evaluation of volcanic eruption hazard

6.1.3. Risk of volcanic eruptions	Points
Very low (no eruptions)	100
Low (eruption status uncertain)	75
Moderate (last eruption before 1800 AD)	50
High (last eruption after 1800 AD)	5
Very High (particularly hazardous volcanoes)	0
Indicator evaluation for ESH	**100**

6.6.1.1d Risk of tsunamis

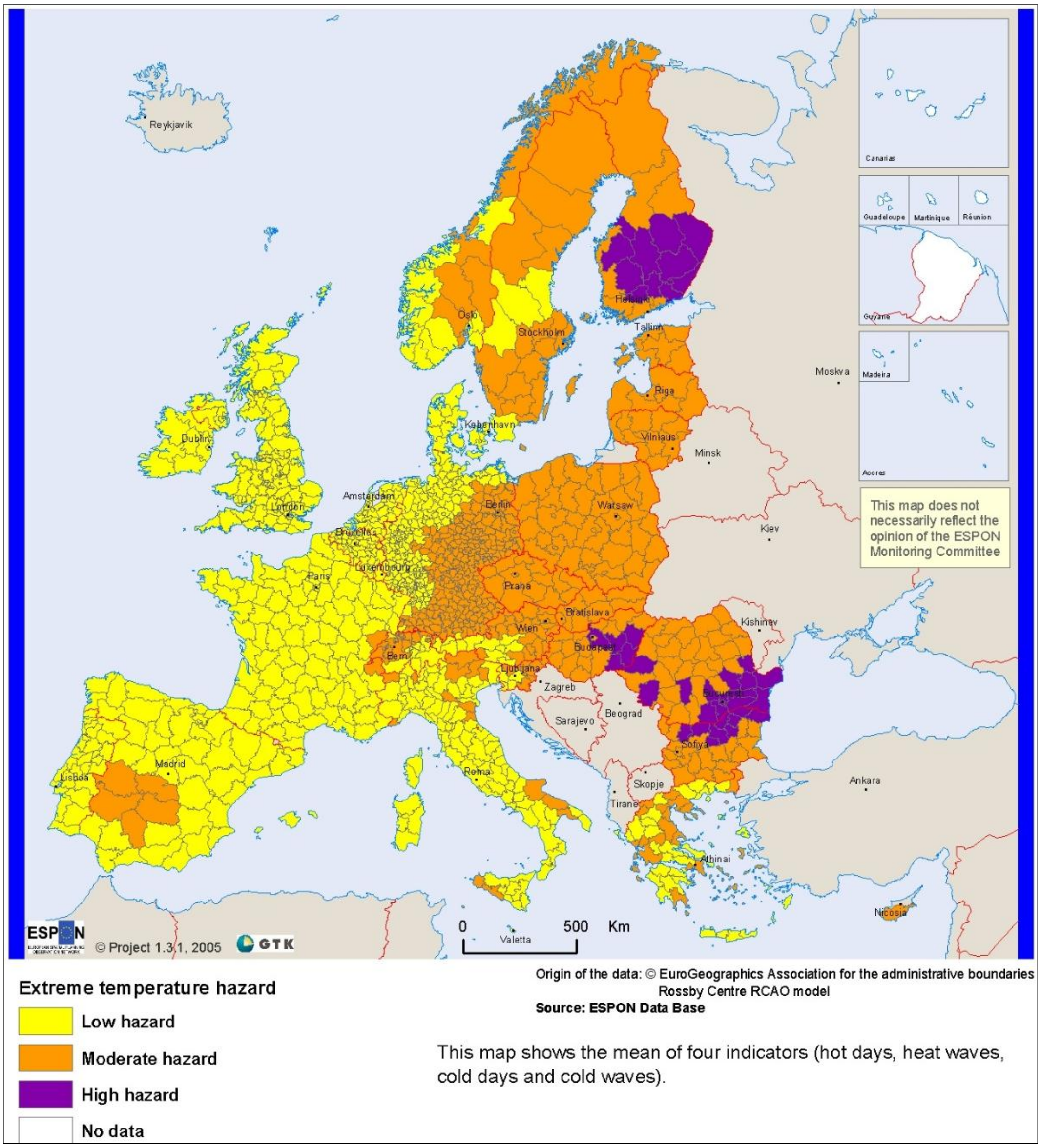
There are no risks regarding tsunamis in Ljubljana.

Table 117: Evaluation of tsunami hazard

6.1.4.Risk of tsunami	Points
Very low hazard	100
Moderate hazard	50
Very high hazard	0
Indicator evaluation for ESH	**100**

6.6.1.1e Extreme temperatures

According to ESPON Ljubljana lies in the zone with low extreme temperature hazard.



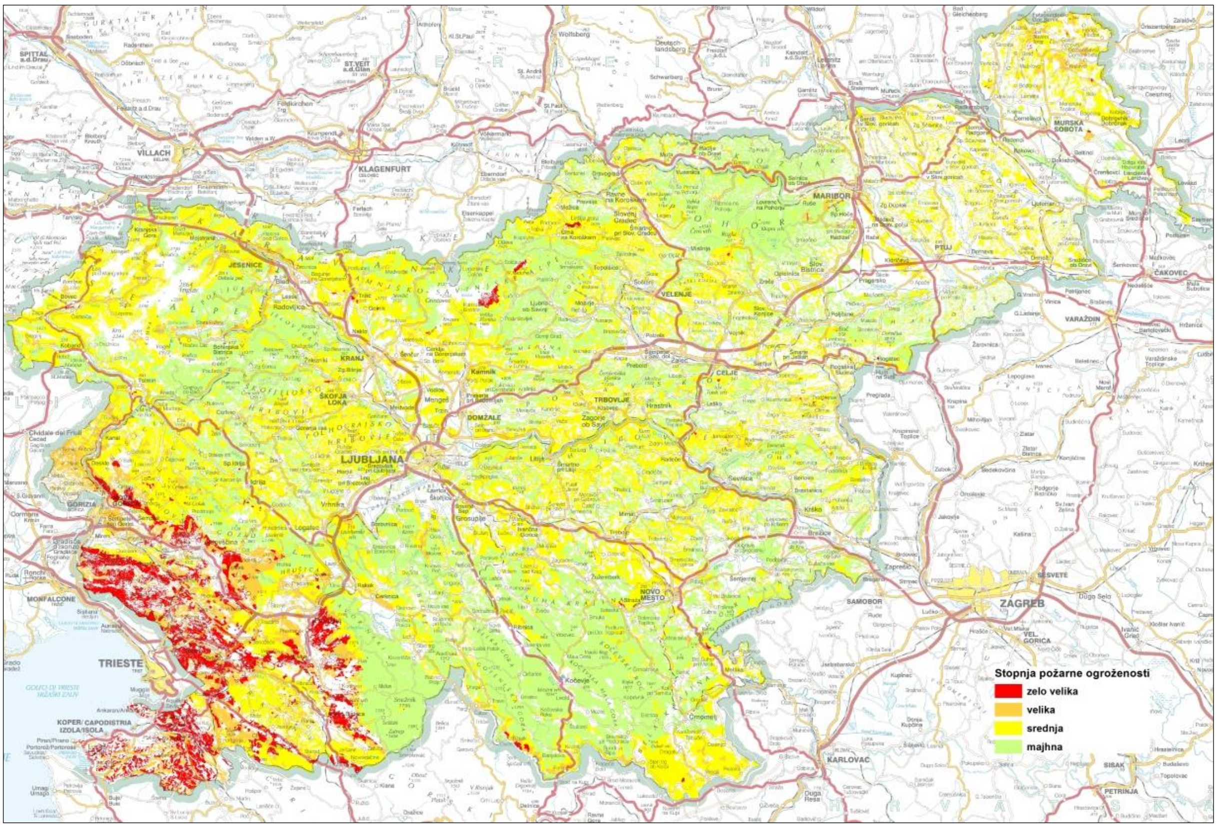
Picture 30: Extreme temperature hazard potential (Source: ESPON)

Table 118: Evaluation of extreme temperatures hazard

6.1.5. Risk of extreme temperature	Points
Low hazard	100
Moderate hazard	50
High hazard	0
Indicator evaluation for ESH	**50**

6.6.1.1f Forest fires

No risk of forest fires in Ljubljana.



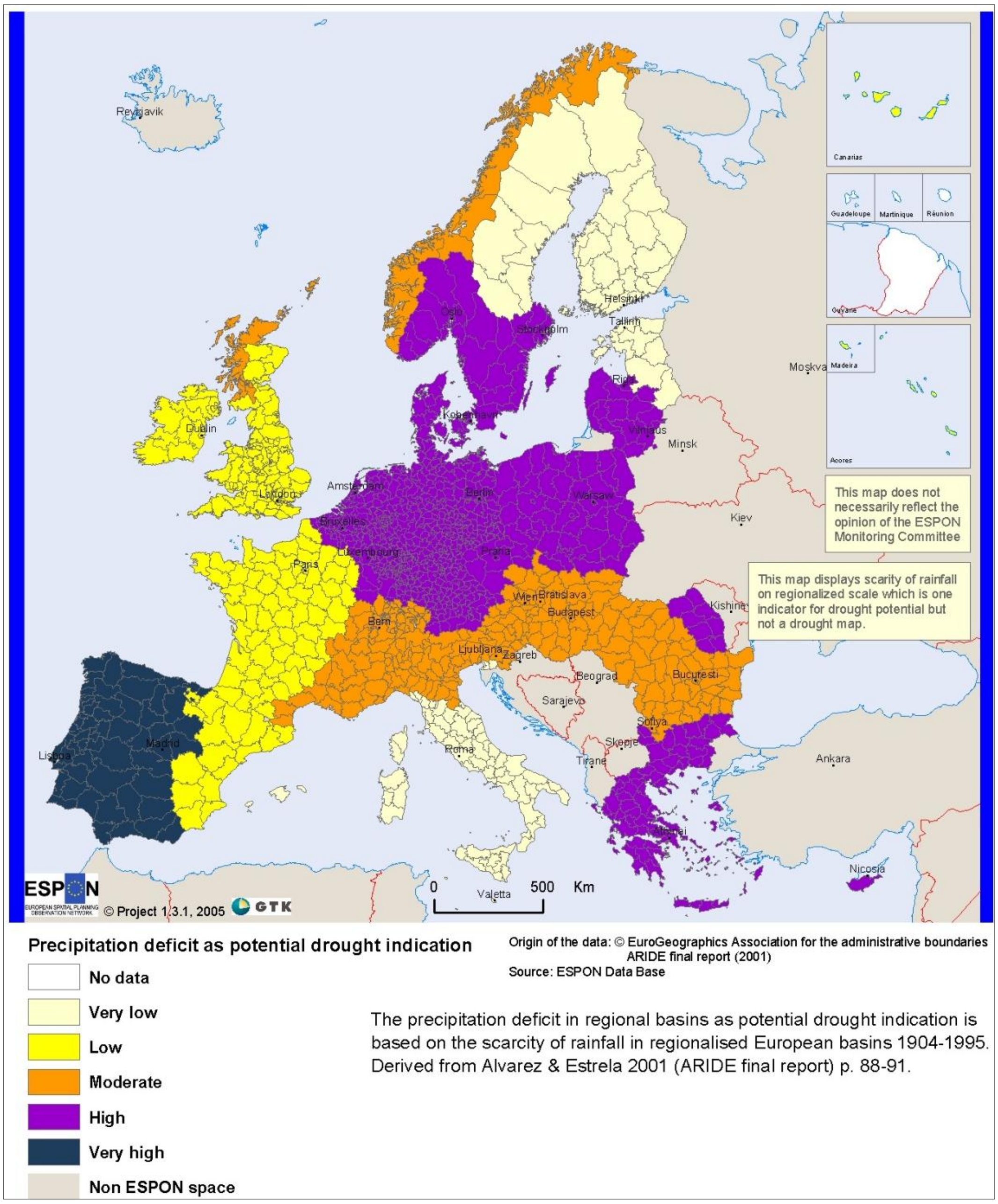
Picture 31: Risk of forest fires, Slovenia (Source: Slovenia forest service)

Table 119: Evaluation of forest fire hazard

6.1.6. Risk of forest fire	**Points**
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0
Indicator evaluation for ESH	**100**

6.6.1.1g Drought

According to ESPON Ljubljana lies in the zone with moderate drought hazard.



Picture 32: Drought potential (Source: ESPON)

Table 120: Evaluation of drought potential

6.1.7. Risk of droughts	**Points**
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0
Indicator evaluation for ESH	**50**

6.6.1.1h Floods

Location of ESH in Ljubljana is not in the area within 500-year-flood boundaries.

Picture 33: 500-year-flood boundaries; Ljubljana (Source: Slovenian Environment Agency – ARSO)

Table 121: Evaluation of flood hazard

6.1.8. Risk of flood	**Points**
Existence of attenuation measures (exclusively if the risk of flood = “moderate”, “high” or “very high”)	(+25)
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0
Indicator evaluation for ESH	**100**

6.6.1.1i Storms

Table 122: Evaluation of storm hazard

6.1.9. Risk of storms	**Points**
Very low hazard	100
Medium hazard	50
High/very high hazard	0
Indicator evaluation for ESH	**50**

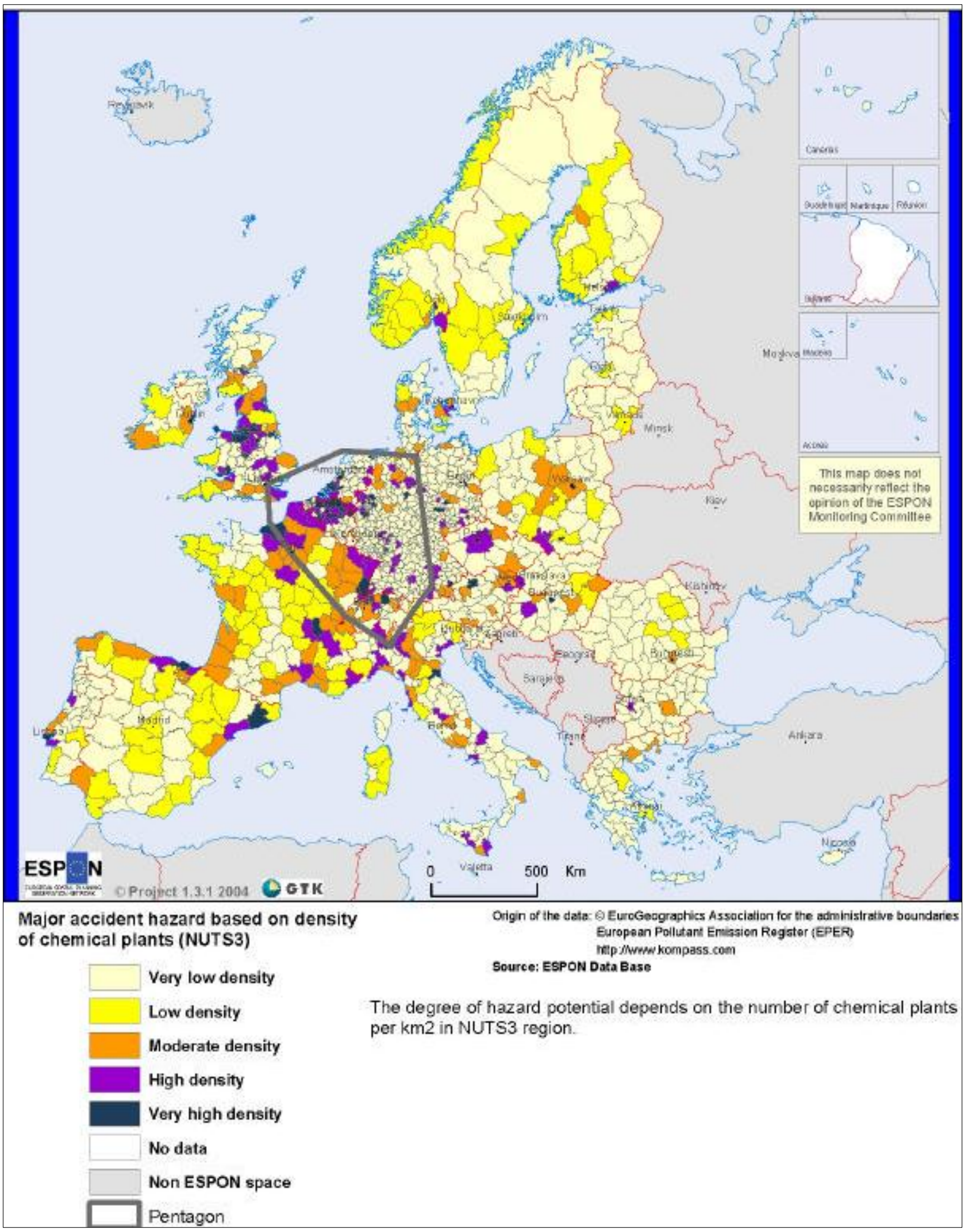
6.6.1.1j Avalanches

Table 123: Evaluation of avalanche hazard

6.1.10. Risk of avalanche	**Points**
Very low hazard	100
Very high hazard	0
Indicator evaluation for ESH	**100**

6.6.1.1k Technological hazard/Chemical plants accidents

According to ESPON Ljubljana lies in the region with low density of chemical plants.



Picture 34: Density of chemical plants (Source: ESPON)

Table 124: Evaluation of technological hazard

6.1.11. Technological hazard/Chemical plants accidents	Points
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0
Indicator evaluation for ESH	**100**

6.6.1.1l Technological hazard/Contaminant release and explosions

Indicator includes oil production, processing, transportation and storage aspect of safety hazard.

Table 125: Evaluation of contaminant release hazard

6.1.12. Technological hazard/ Contaminant release and explosions	Points
Very low hazard	100
Low hazard	75
Moderate hazard	50
High hazard	5
Very high hazard	0
Indicator evaluation for ESH	**75**

6.6.1.1m Technological hazard/Radioactive contamination from nuclear power plants accidents

Nearest Krško Nuclear Power Plant (NEK) is within the 30 km to 300 km radius. This is the level of moderate hazard according to OPEN HOUSE.

Table 126: Evaluation of radioactive contamination hazard

6.1.13. Technological hazard/ Radioactive contamination from nuclear power plants accidents	Points
Very low hazard	100
Moderate hazard	50
Very high hazard	0
Indicator evaluation for ESH	**50**

6.6.1.2 Indicator 6.3 Options for Transportation

Indicator addresses accessibility to transportation systems (especially low carbon schemes) in the proximity of building. The goal of this indicator is to define the effective and shortest distance in metres from a main building entrance to local public means of transportation.

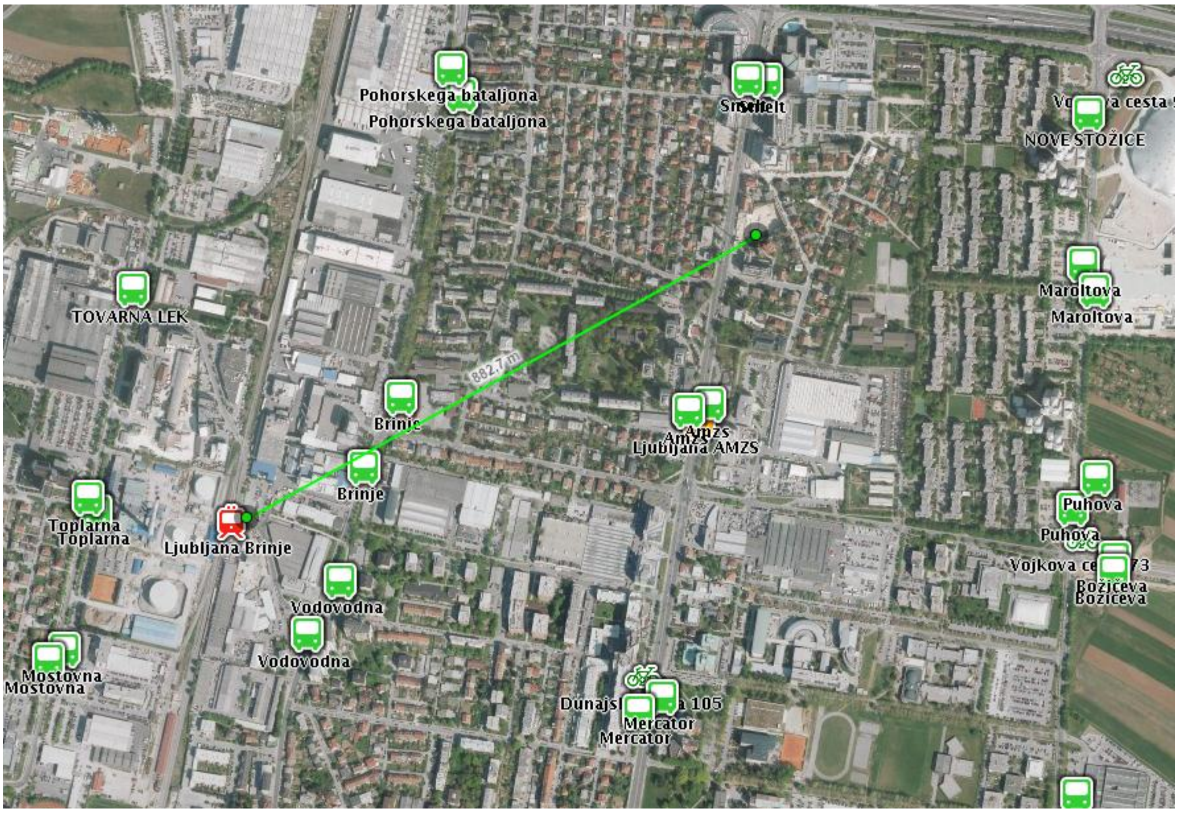
Only public transportation services are addressed here. Indicator takes into account next sub indicators:

- Accessibility of the nearest railroad station from a main building entrance
- Accessibility of the nearest public local transportation stop (bus, rapid city train, tram, metro)
- Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines
- Availability of walking and bicycle paths

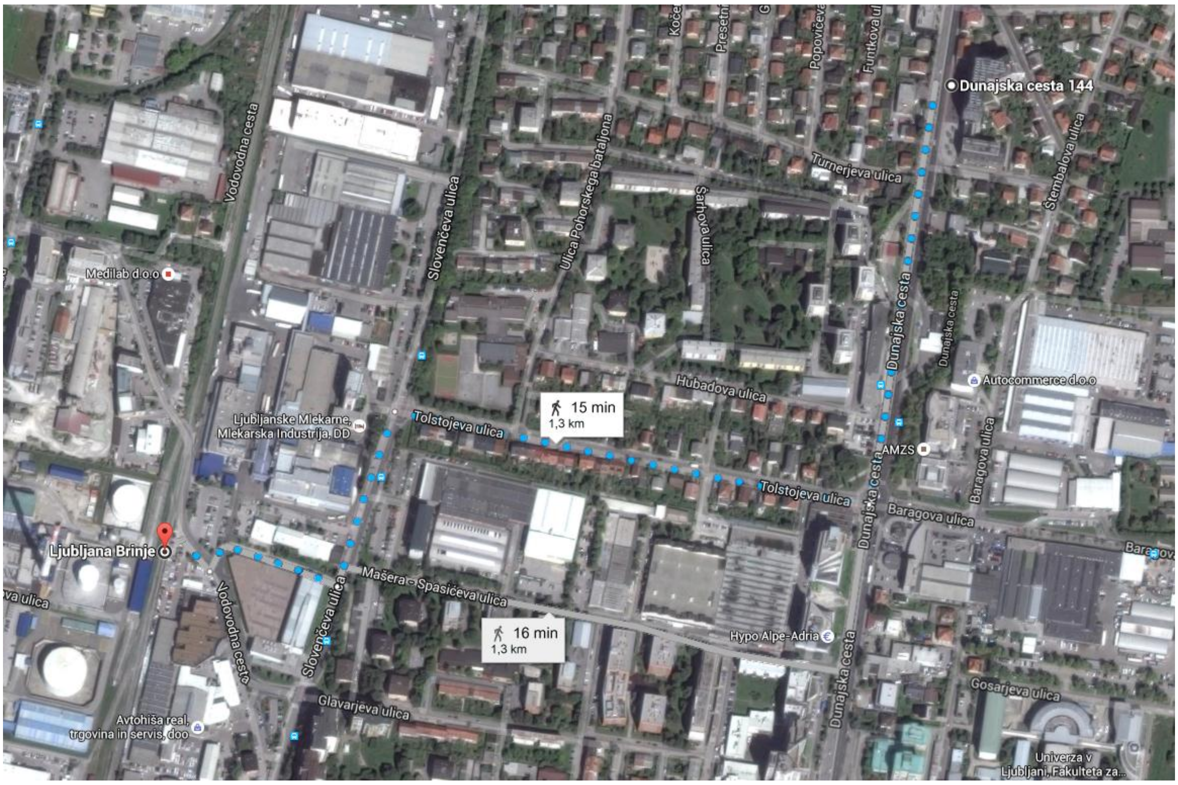
Location of ESH building and transportation services available were evaluated with the help of interactive online map of Slovenia called Geopedia and through data publicly available on the internet by service different providers.

6.6.1.2a Accessibility of the nearest railroad station from a main building entrance

Nearest train station from ESH is train station Ljubljana Brinje that connects the central train station in Ljubljana with city of Kamnik. The walking distance is around 1300 m that takes approximately 15-16 min of walking time.



Picture 35 Nearest train stations Brinje, (source: http://www.geopedia.si)



Picture 36: Nearest train stations Brinje, walking distance, (source: google maps)

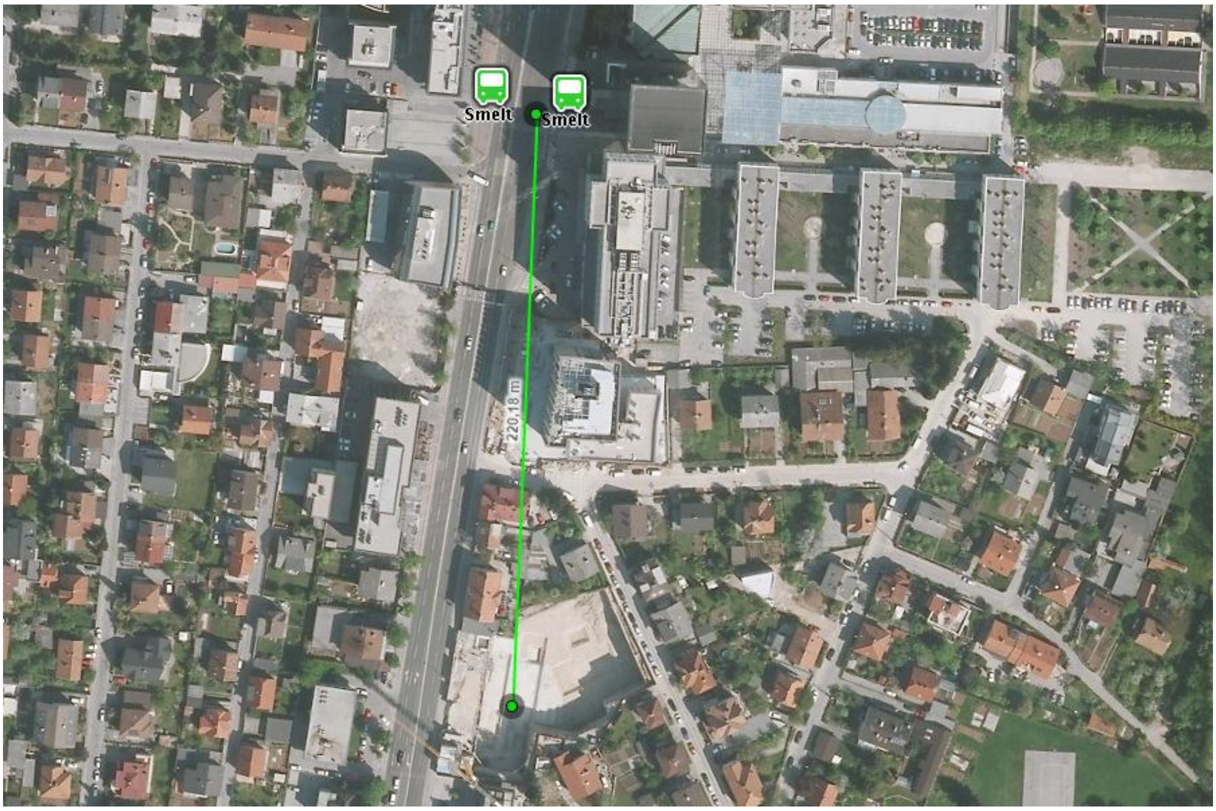
The points awarded to ESH in this section are shown in the table below. Train station is a fraction to distant in order to meet the criteria of OPEN HOUSE evaluation set at 1200 m as the largest distance to train station.

Table 127: Evaluation of railroad connections

6.3.1 Accessibility of the nearest railroad station from a main building entrance in metres	**Points**
< 300 m	100
300 - 500 m	75
500 - 800 m	50
800 - 1200 m	25
>1200 m	0
Indicator evaluation for ESH	**0**

6.6.1.2b Accessibility of the nearest public local transportation stop (bus, rapid city train, tram, metro)

The only public transport service available in Ljubljana is city bus service LPP. Thera are three bus lines (line 6, line 8 and line 11) connecting the nearest bus station Smelt available within walking distance of ESH. The location of ESH is actually one of better locations in Ljubljana from the perspective of availability and connections of city bus service. The nearest bus station Smelt is within 150-300 m of walking distance.



Picture 37: City bus service LPP, nearest buss stations Smelt, (source: http://www.geopedia.si)

The points awarded to ESH in this section are shown in the table below.

Table 128: Evaluation of local public transportation

6.3.2 Accessibility of the nearest public local transportation stop from a main building entrance in metres	**Points**
<150 m	100
150 - 300 m	75
300 - 500 m	50
500 - 1000 m	25
>1000 m	0
Indicator evaluation for ESH	**75**

Table 129: Nearest city bus station, lines and timetables (source: http://www.lpp.si/javni-prevoz/vozni-redi)

Line 6 (bus station Smelt)

LPP
Javno podjetje Ljubljanski potniški promet, d.o.o.
Celovška 160, 1000 Ljubljana
www.lpp.si

6

Odhodi s postajališča: **103071 Smelt**

v smeri: **Dolgi most P+R**

Čas vožnje v minutah

	ČRNUČE
	Rogovilc
	Kolodvor Črn.
	Sava
	Ježica
	Ruski car
	Stožice
	Smelt
1	AMZS
2	Mercator
3	Stadion
5	Astra
6	Razstavišče
8	Kozolec
10	Ajdovščina
12	Konzorcij
13	Drama
14	Aškerčeva
16	Tobačna
17	Hajdrihova
18	Stan in dom
19	Glince
20	Vič
21	Bonifacija
22	Dolgi most
23	D. MOST P+R

ura	Delavnik minute	Sobota minute	Nedelja, prazniki minute
02			
03	20	20	
04	00 40	00 40	20
05	04 19 34 50	18 38 58	00 40
06	05 20 33 44 54	18 37 55	03 28 53
07	04 14 25 35 44 56	10 25 41 56	18 43
08	06 14 24 33 45 57	11 25 39 53	08 33 58
09	09 23 37 52	09 24 39 54	18 38 58
10	07 22 37 52	09 24 39 54	18 33 48
11	06 20 34 49	09 25 41 57	08 28 48
12	04 19 34 49	13 29 45	08 28 46
13	03 17 31 45 57	01 17 32 48	04 22 40 58
14	09 21 33 44 57	04 20 36 52	19 39 59
15	09 20 31 42 53	09 24 38 54	18 38 56
16	05 17 29 41 53	10 28 46	15 33 51
17	05 18 32 47	04 22 40 58	09 27 45
18	01 15 29 43 57	16 33 50	01 21 41
19	11 25 38 52	08 28 48	03 24 46
20	06 20 34 48	08 28 48	08 28 48
21	03 18 33 49	08 28 49	08 28 49
22	04 19 49	19 49	19 49
23	29	29	29
00	09 45G	09 45G	09 45G
01			

Opombe:
G - pomeni odhod s končne postaje v garažo

Vozni red velja od 27.06.2016do 31.08.2016

Line 8 (bus station Smelt)

LPP
Javno podjetje Ljubljanski potniški promet, d.o.o.
Celovška 160, 1000 Ljubljana
www.lpp.si

8

Odhodi s postajališča: 103071 **Smelt**

v smeri: **Gameljne**

Čas vožnje v minutah

min	Postaja
	BRNČIČEVA
	Slovenijales
	Cesta na Brod
	Obrtna cona
	Šlandrova
	Elma
	Sava
	Ježica
	Ruski car
	Stožice
	Smelt
1	AMZS
2	Mercator
3	Stadion
5	Astra
6	Razstavišče
8	Kozolec
11	Gosposvetska
12	Tivoli
13	Stara cerkev
15	Kino Šiška
17	Slovenija avto
18	Litostrojska
19	Ljub. brigade
21	Tehnounion
22	IMP
23	Prušnikova
24	Podgora
25	Šentvid
26	Kosmačeva
27	Na klancu
29	Tabor
30	Ob daljnovodu
31	Tacenski most
32	Tacen
33	Šmartno
35	Zg.Gameljne
36	Rašica
37	GAMELJNE

Delavnik ura	Delavnik minute	Sobota minute	Nedelja, prazniki minute
02			
03			
04			
05	11 29^P 46	21 46	
06	05^P 27 46^P	06 26 45^P	
07	03 18^P 34 49	05 26 45	
08	05^P 20 35 55	05^P 31 56	
09	12^P 33 53	21^P 46	
10	16 37^P 58	12 37^P	
11	19 40	02 26 51^P	
12	01^P 21 42	16 41	
13	03^P 24 46^P	06^P 31 56	
14	07 26^P 45	21^P 46	
15	00^P 16^P 32^P 48	11 36^P	
16	04 21^P 38 56	01 26 51^P	
17	14^P 32 52^P	16 41	
18	12 32^P 51	06^P 31 56	
19	11^P 31 52	21^P 46	
20	13^P 34 54	11 31^P 54	
21	14^P 34 55	14 34 55	
22	14^G 34^G	14^G 39^G	
23			
00			
01			

Opombe:

G - pomeni odhod s končne postaje v garažo

P - označuje odhod, ki je primeren za prestop na linijo 21 s prestopanjem na končni postaji Gameljne.

- linija 08 ob nedeljah in praznikih ne obratuje, nadomešča jo linija 1B

Vozni red velja od 27.06.2016do 31.08.2016

Line 11 (bus station Smelt)

LPP
Javno podjetje Ljubljanski potniški promet, d.o.o.
Celovška 160, 1000 Ljubljana
www.lpp.si

11

Odhodi s postajališča: 103071 **Smelt**

v smeri: **Zalog**

Čas vožnje v minutah

	JEŽICA P+R
	Ježica
	Ruski car
	Stožice
	Smelt
1	AMZS
2	Mercator
4	Stadion
5	Astra
7	Razstavišče
8	Kozolec
10	Ajdovščina
12	Konzorcij
13	Drama
15	Križanke
16	Gornji trg
17	Privoz
19	Streliška
20	Roška
22	Klinični center
24	Bolnica
25	Tržnica Moste
27	Zaloška
29	Pot na Fužine
30	Archinetova
31	Osenjakova
32	Chengdujska
34	Studenec
36	Polje
37	Cesta na Vevče
39	Petrol
40	Silos
41	Zadružni dom
43	Zeleni gaj
44	ZALOG

Delavnik		Sobota	Nedelja, prazniki
ura	minute	minute	minute
02			
03			
04	58		
05	24 40 56		
06	12 28 43 57		
07	13 30 48		
08	05 25 45		
09	05 25 46		
10	08 29 50		
11	10 30 50		
12	10 30 50		
13	10 29 47		
14	03 19 36 53		
15	09 25 44		
16	01 19 37 55		
17	14 32 49		
18	07 25 45		
19	05 25 45		
20	05 25 44		
21	04		
22			
23			
00			
01			

Opombe:
- ob nedeljah in praznikih med 6.00 in 22.30 uro do Zaloga vozi linija 20 kot linija 20Z na relaciji NOVE STOŽICE P+R - ZALOG preko Fužin

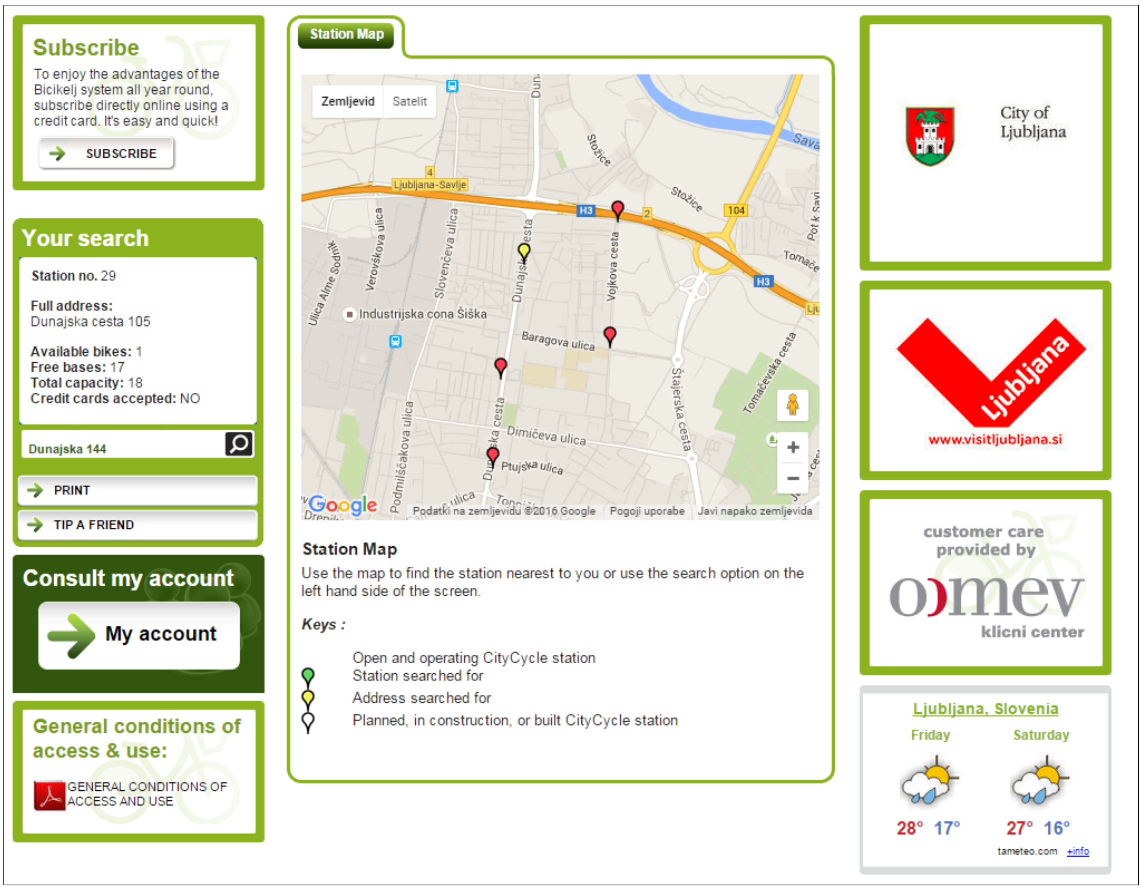
Vozni red velja od 27.06.2016do 31.08.2016

6.6.1.2c Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines

The evaluation of this indicator depends on the existence of listed services available within radius of 1 km from the building:

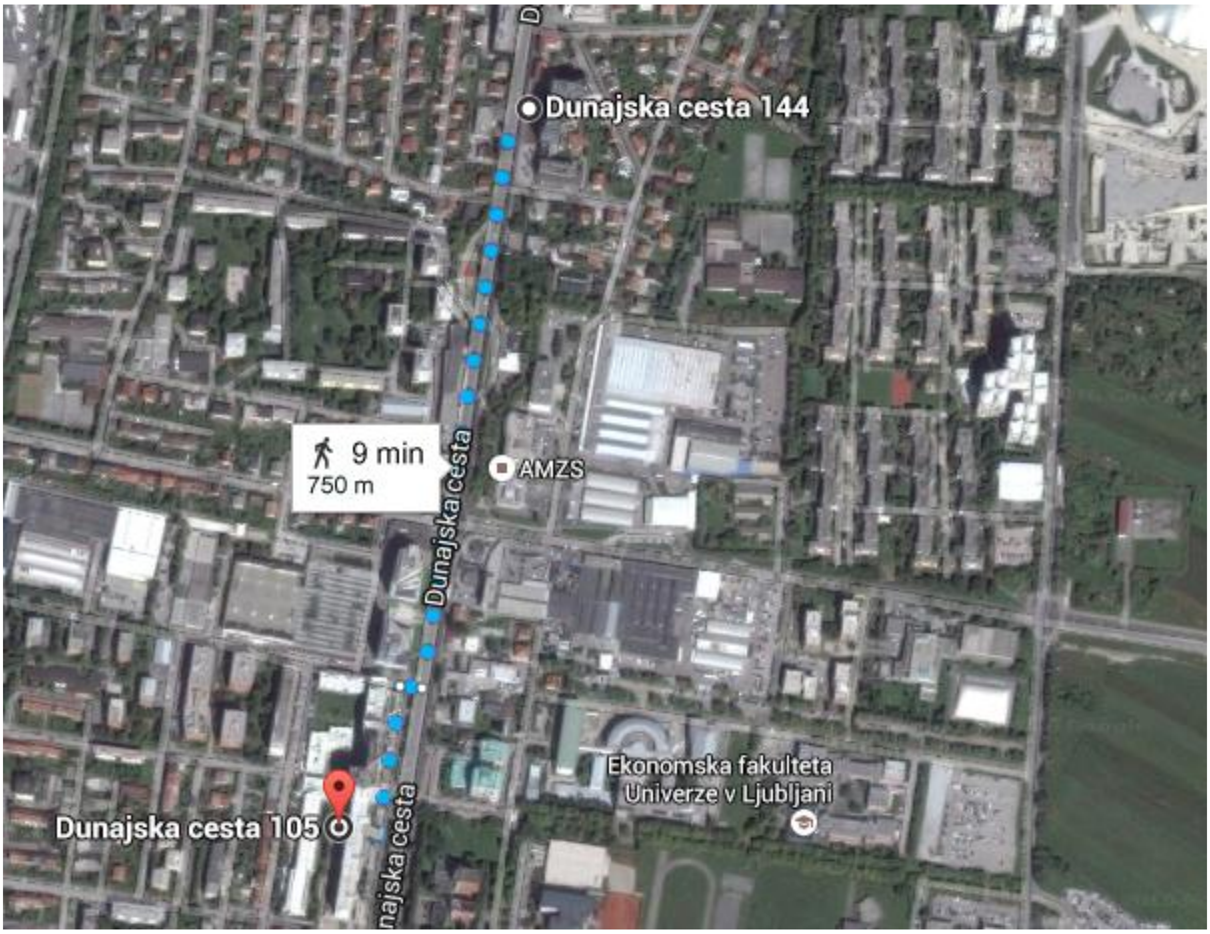
- City bicycle scheme
- Car club scheme
- Charging infrastructure for electric/hybrid vehicles
- Electric/hybrid bus lines

City of Ljubljana voted as a Green Capital of Europe 2016[5] places effort also in greener public transportation. Bike sharing service with the wide network of bicycle roots and bike stations called BicikeLJ[6] is available to general public. The nearest bicycle station was checked on official web page of BicikeLJ and is located on Dunajska cesta 105. Results of search bellow.



Picture 38: City bike sharing service, nearest bicycle station; (source: http://en.bicikelj.si/All-Stations/Station-Map#)

[5] http://www.greenljubljana.com/?_ga=1.246727619.696791644.1467971893
[6] http://en.bicikelj.si/



Picture 39: Nearest bicycle station; walking distance, (source: google maps)

Walking distance to nearest bicycle station is 750 m or approximately 9 min of walking time.

Regarding different car club schemes in proximity, there is a rental service available Avantcar[7] located in close proximity of ESH. Car rental service offers also the rental of electric vehicles. Charging infrastructure for electric vehicles is also provided within the premises of ESH building.

There are no specific electric/hybrid bus lines currently available in Ljubljana outside the city centre for general public usage.

ESH therefore has 3 of of 4 main services available for users. Evaluation of indicator in the table below.

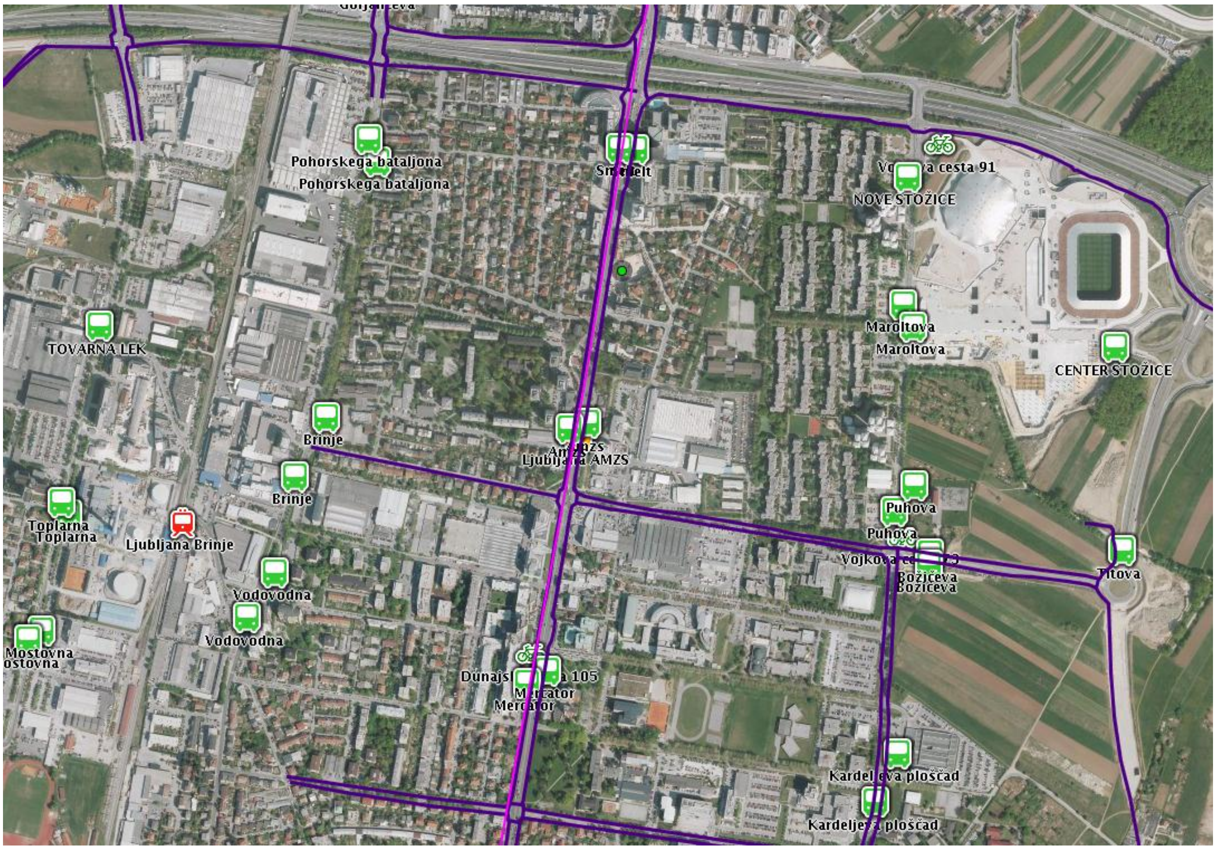
[7] http://www.avantcar.si/en/general/locations/ljubljana/

Table 4: Evaluation of modern low emission transportation options

6.3.3 Availability of modern low emission transport options: city bicycle scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines within radius of 1 km from the building	**Points**
4 options	100
3 options	75
2 options	50
1 option	25
0 options	0
Indicator evaluation for ESH	**75**

6.6.1.2d Availability of walking and bicycle paths

Availability of walking and bicycle paths was with the help of interactive map of Slovenia called Geopedia, where the map with the main bicycle roots and main walkways can be obtained.



Picture 40: Walking and bicycle paths near ESH; (source: http://www.geopedia.si/)

Location of ESH building is shown on the map. Location of ESH is marked with the small green dot. Main bicycle paths are shown with purple lines. Pink line shows the main walkway.

Map also shows the bus stations (green vehicle), railroad station (red vehicle) and bike stations of bike sharing service BicikeLJ (green bike).

Location of ESH is in the close proximity along the developed walking and bicycle paths. Evaluation of indicator below in the table.

Table 130: Evaluation of availability of walking and bicycle paths

6.3.4 Availability of walking and bicycle paths	**Points**
The location lies along a developed network of walkway and bicycle paths.	100
The location lies along a developed network of walkway and bicycle paths are not developed yet but in planning.	50
The location has average accessibility by foot or bicycle	10
The location is practically impossible or impracticable to reach by either foot or bicycle (e.g. industrial area, freeway rest area, etc.).	0
Indicator evaluation for ESH	**100**

6.6.2 SCORING CARD FOR LOCATION INDICATORS

Result of 65,38 points out of 100 possible for transportation options of ESH building users show good result. It has to be specified that the nearest train station is just about 100 meters short than the requirement specified in OPEN HOUSE methodology therefore 0 points was awarded for this sub indicator. Train station Ljubljana Brinje, is a part of national intercity railroad network and If we would actually take into account a current state of the art on this field, having a train station within the 3-5 km would already be a great result. In addition, there is also option of taking the direct line of city bus service to the main Ljubljana central train station. Availability of other forms of transportation evaluated here is very good.

Table 131: Scoring card for Location (Core indicators)

The Location					
6.1	**Risks at the Site**			**77,08**	**3,12**
6.1.1	Earthquakes	50	2		
6.1.2	Landslides	100	3		
6.1.3	Volcanic eruptions	100	1		
6.1.4	Tsunamis	100	1		
6.1.5	Extreme temperatures	50	2		
6.1.6	Forest fires	100	2		
6.1.7	Drought	50	1		
6.1.8	Floods	100	2		
6.1.9	Storms	50	3		
6.1.10	Avalanches	100	1		
6.1.11	Technological hazard/Chemical plants accidents	100	2		
6.1.12	Technological hazard/Contaminant release and explosions	75	2		
6.1.13	Technological hazard/Radioactive contamination from nuclear power plants accidents	50	2		
6.3	**Options for Transportation**			**65,38**	**2,84**
6.3.1	Accessibility of the nearest railroad station	0	3		
6.3.2	Accessibility of the nearest public local transportation stop	75	3		
6.3.3	Availability of modern low emission transport options: city bike scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines	75	3		
6.3.4	Availability of Walking and Bike Path	100	4		

7. RESULTS OF SUSTAINABILITY ASSESEMENT

Result of sustainability evaluation for ESH building is 72,5 points, that shows good overall performance of building. Result of evaluation includes aspects of environmental, social/functional and economic quality of building. This are three main categories taken into account for overall score of building sustainability evaluation. Each of these categories is weighted equally. Each category is widget as 1/3 of overall performance.

Individual indicators from economic quality category take into account also individual indicators from technical characteristics category, such as Quality of the building shell, Cleaning and maintenance, further more individual indicators from process quality category such as Handover and Performance Evaluation are also taken into account.

Best score for ESH building was achieved in social/functional and economic quality of building. Good results in social/functional quality were expected, since the extra effort was put in securing good thermal environment and easy to operate control systems.

In the environmental quality section, the building shows god overall performance. Above standard score in this section is achieved through reduced energy consumption of ESH building. Use of building construction materials, such as heat insulation, is strongly dictated through different construction regulations. This regulations have direct effect on the choice of materials that can be used in construction and therefore can have indirect effect on sustainability performance of building. For examples, Rules on fire safety in buildings require high level of fire protection for buildings like ESH. That means, that majority of materials used in thermal envelope of building or other construction components have to be within highest class of A1, A2, B that have no or low contribution to fire. Building materials from renewable resources, such as heat insulation made from wood fibre, generally don't meet the requirements of fire regulations for this type of buildings as ESH. Therefore thermal insulation from glass or rock wool has to be used and that lowers results of sustainability assessment. Fire safety definitely should not be compromised but it is one aspect of sustainability assessment that should be taken into account within sustainability assessment.

All the relevant indicators were considered within this sustainability assessment. In the scoring card below, scores for all indicators and performance for each category for ESH are available.

Table 132: Results of sustainability assessment for ESH (SCORING CARD)

OPEN HOUSE Scoring Card
Assessment Guideline v1.2 (July/2013)

Overall Score %	72,5
	60,1
	79,6
	77,9

Please select your country to define the weights:

Slovenia

Only fill in the cells with a blue font.

			Sub-indicator Score %	Sub-indicator Weight [EU]	Indicator Score %	Indicator Weighting (Slovenia)	Indicator Weight in Overall Score (Slovenia)	Category Score %	Category Weighting
Environmental Quality								**60,1**	**1/3**
1.1	**Global Warming Potential (GWP)**				**70,37**	**4,00**	**3,59%**		
	1.1.1	Global Warming Potential (GWP)	70,37	4					
1.2	**Ozone Depletion Potential (ODP)**				**54,61**	**3,85**	**3,46%**		
	1.2.1	Ozone Depletion Potential (ODP)	54,61	4					
1.3	**Acidification Potential (AP)**				**49,57**	**2,29**	**2,05%**		
	1.3.1	Acidification Potential (AP)	49,57	4					
1.4	**EutrophicationPotential (EP)**				**49,70**	**2,29**	**2,05%**		
	1.4.1	EutrophicationPotential (EP)	49,70	4					
1.5	**Photochemical Ozone Creation Potential (POCP)**				**48,99**	**2,38**	**2,14%**		
	1.5.1	Photochemical Ozone Creation Potential (POCP)	48,99	4					
1.7	Biodiversity and Depletion of Habitats				**40,00**	**2,71**	**2,43%**		
	1.7.1	Change in ecological value of the site	40	4					
1.8	Light Pollution				**100,00**	**2,09**	**1,88%**		

		1.8.1	Light on properties	100	4				
		1.8.2	Luminaire intensity	100	4				
		1.8.3	Upward light	100	4				
		1.8.4	Luminance	100	4				
1.9	**Abiotic depletion of non renewable fossil fuels due to non renewable Primary Energy Demand (ADP_Enr)**					**73,11**	**3,55**	**3,19%**	
		1.9.1	Abiotic Depletion Potential (ADP_Enr)	73,11	4				
1.10	**Total Primary Energy Demands and Share of Renewable Primary Energy**								
		1.10.1	Total Primary Energy Demand	37,71	4	**52,71**	**3,72**	**3,34%**	
		1.10.2	Share of renewable Primary Energy in Total Primary Energy Demand	15	-				
1.11	**Water and Waste Water**					**50,00**	**2,59**	**2,33%**	
		1.11.3	Operational Water Use and Waste Water	50	4				
1.12	**Land use**								
		1.12.1	Site location	50	4	**43,33**	**1,95**	**1,76%**	
		1.12.2	Imperviousness change	30	2				
1.13	**Waste**								
		1.13.1	Recyclable Waste Storage	100	4	**50,00**	**2,73**	**2,45%**	
		1.13.2	Composting	0	4				
1.14	Energy efficiency of building equipment (lifts, escalators and moving walkways)								
		1.14.1	Stairs and ramps planning	100	4				
		1.14.2	Lift design and efficiency	80	4	**100,00**	**2,35**	**2,11%**	
		1.14.3	Escalator design and efficiency	80	4				
		1.14.4	Moving walkway design and efficiency	80	4				
1.15	**Contribution to the depletion of abiotic resources - non fossil fuels (ADPelement)**					**57,73**	**0,60**	**0,54%**	
		1.15.1	Abiotic Depletion Potential (ADPelements)	57,73	4				
Social / Functional Quality									**79,6**
2.1	**Barrier-free Accessibility**								
		2.1.1	Barrier-free Accessibility	100	1	**100,00**	**3,09**	**3,00%**	
2.2	Personal Safety and Security of Users								**1/3**
		2.2.1	The satisfaction of minimum health and safety requirements in the workplace	100	4				
		2.2.2	Reduction of the extent of damage if an accident should occur inside and outside the building	100	4	**100,00**	**2,84**	**2,76%**	
		2.2.3	Measures preventing building users from crime	100	2				

2.3	**Thermal Comfort**						
2.3.1	Operative temperature	75	4	**87,50**	**3,40**	**3,30%**	
2.3.2	Radiant temperature asymmetry and floor temperature	100	1				
2.3.3	Draught, air velocity	100	2				
2.3.4	Humidity in indoor air	100	1				
2.4	**Indoor Air Quality**						
2.4.1	Occupancy-based ventilation rates	100	4	**95,00**	**4,00**	**3,88%**	
2.4.2	Indoor air contamination with the most relevant indoor air pollutants (formaldehyde, naphtalene, toluene, xylene, styrene) [Existing buildings]	100	4				
2.4.3	CO2 concentration above outdoor level [Existing buildings]	100	4				
2.4.4	Subjective reaction as classification of the indoor air quality [Existing buildings]	100	4				
2.4.5	Occurrence of Radon	75	4				
2.5	Water Quality						
2.5.1	Constant Water Supply through the day	100	4	**66,67**	**3,26**	**3,16%**	
2.5.2	Use of alternative water supplies	100	4				
2.5.3	Water Disinfection	0	4				
2.6	**Acoustic Comfort**						
2.6.1	Indoor ambient noise levels in unoccupied staff/office areas	100	4	**100,00**	**2,39**	**2,32%**	
2.6.2	Reverberation period	100	4				
2.7	**Visual Comfort**						
2.7.1	Availability of daylight throughout the building	100	4	**88,00**	**2,54**	**2,46%**	
2.7.2	Availability of daylight in regularly used work areas	100	4				
2.7.3	View to the outside	75	3				
2.7.4	Preventing glare in daylight	75	3				
2.7.5	Preventing glare in artificial light	100	3				
2.7.6	Light distribution in artificial lighting conditions	100	3				
2.7.7	Color rendering	50	3				
2.7.8	Blinking and flashing lights	100	2				
2.8	**Operation Comfort**						
2.8.1	Ventilation	100	3	**100,00**	**2,36**	**2,29%**	
2.8.2	Shading	100	3				
2.8.3	Glare prevention	100	3				
2.8.4	Temperatures during the heating period	100	3				
2.8.5	Temperatures outside the heating period	100	3				

	2.8.6	Regulation of daylight and artificial light	100	3			
	2.8.7	Ease of operation	100	4			
2.9	Service Quality				52,50	1,82	1,76%
	2.9.1	Availability of services in the building	30	4			
	2.9.2	Service integration in building connected outdoor areas	75	4			
2.11	**Public Accessibility**				100,00	2,04	1,98%
	2.11.1	General public access to the building	100	4			
	2.11.2	External facilities open to the public	100	2			
	2.11.3	Interior facilities, such as libraries or cafeteria, open to the public	100	2			
	2.11.4	Possibility of third party to rent rooms in the building	100	2			
	2.11.5	Variety of uses for public areas	100	4			
2.12	Noise from Building and Site				0,00	1,85	1,79%
	2.12.1	Noise from Building and Site	0	4			
2.16	**Bicycle Amenities**				100,00	2,24	2,17%
	2.16.1	Number of bicycle parking spaces available for building users	100	4			
	2.16.2	Distance to bicycle parking system from a main building entrance	100	3			
	2.16.3	Existence of facilities for bicycle comfort and security	100	3			
2.17	**Material Sourcing**				10,00	2,55	2,47%
	2.17.1	Material Sourcing: Wood	10	4			
Economic Quality							77,9
3.1	**Building-related Life Cycle Costs (LCC)**				97,14	4,00	17,87%
	3.1.1	Life cycle costs	95	4			
	3.1.3	Sensitivity analysis [design phase]	100	3			
3.2	Value Stability				55,63	3,46	15,47%
	3.2.1	Area Efficiency	100	2			
	3.2.2	Conversion feasibility	30	4			
	3.2.3	Energy and water dependency	75	1			
	3.2.4	Building performance management	50	1			
Technical Characteristics							
4.3	Cleaning and maintenance				48,33	4,00	
	4.3.1	Load-bearing structure	50	4			
	4.3.2	Non-load-bearing external structures	50	4			

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	4.3.3	Non-load-bearing interior structures	45	4			
4.5		Noise Protection			Not	Assessed	(not a core indicator)
	4.5.1	Airborne sound insulation with respect to exterior sound	0	4			
	4.5.2	Airborne sound insulation with respect to other working areas and to personal working areas	0	4			
	4.5.3	Insulation from impact sound with respect to other working areas and to personal working areas	0	4			
	4.5.4	Insulation from sound created by building services (water system and other services)	0	4			
4.6		**Quality of the building shell**			**100,00**	**3,53**	
	4.6.1	Median thermal transmittance coefficients of building components Ū	100	3			
	4.6.2	Thermal Bridges	100	1			
	4.6.3	Air permeability class (window air-tightness)	100	3			
	4.6.4	Amount of condensation inside the structure	100	2			
	4.6.5	Air exchange n_{50} and if necessary q_{50}	100	1			
	4.6.6	Solar heat protection	100	1			
4.7		**Ease of Deconstruction, Recycling, and Dismantling**			**36,67**	**3,61**	
	4.7.1	Effort for dismantling /disassembly – divided into 5 steps	50	4			
	4.7.2	Effort for sorting/separation – divided into 3 steps	10	4			
	4.7.3	Verification of the inclusion of a recycling/disposal concept with information about construction components in the certification application	50	4			
Process Quality							
5.1		**Project Brief Strategy**			**75,00**	**4,00**	
	5.1.1	Project Brief	100	3			
	5.1.2	Architectural competition	0	1			
5.2		Integrated Planning			Not	Assessed	(not a core indicator)
	5.2.1	Multidisciplinary formation of the planning team	0	4			
	5.2.2	Qualification of the Integrated Project Team	0	4			
	5.2.3	Design Charrette / Preparation of consultation	0	4			
	5.2.4	Integrated planning process	0	4			
	5.2.5	Participation of future building users and other relevant stakeholders / Community impact consultation	0	4			
5.3		Building Performance Targets			Not	Assessd	(not a core inducator)
	5.3.1	Energy target	0	4			
	5.3.2	Water target	0	4			

	5.3.3	Waste concept	0	4			
	5.3.4	Optimization of daylight and artificial lighting	0	4			
	5.3.5	Conversion, dismantling and recycling	0	4			
	5.3.6	Concept for ease of cleaning and maintenance	0	4			
5.4	Evidence of Sustainability during Bid Invitation and Awarding				**Not**	**Assessed**	**(not a core indicator)**
	5.4.1	Integration of Sustainability Aspects during Bid Invitation	0	4			
	5.4.2	Integration of Sustainability Aspects during Awarding	0	4			
5.5	**Construction Site impact/ Construction Process**				**27,50**	**3,15**	
	5.5.1	Low-waste and recycling on construction site	100	4			
	5.5.2	Low-noise construction site	10	4			
	5.5.3	Low-dust construction site	0	4			
	5.5.4	Environmental protection at the construction site	0	4			
5.6	Quality of the Executing Contractors/Pre-Qualification				**Not**	**Assessed**	**(not a core indicator)**
	5.6.1	Quality of Executing Contractors / Pre-Qualification	0	4			
5.7	Quality Assurance of Construction Execution				**Not**	**Assessed**	**(not a core indicator)**
	5.7.1	Documentation of the materials, auxiliary materials, and safety data sheets	0	4			
	5.7.2	Measurements for quality control	0	4			
5.8	**Commissioning**				**100,00**	**3,84**	
	5.8.1	Commissioning process management and documentation	100	4			
5.9	Handover and Performance Evaluation				**87,50**	**3,93**	
	5.9.1	Handover & Documentation	100	4			
	5.9.2	Building Performance Improvement	75	4			
The Location							
6.1	**Risks at the Site**				**77,08**	**3,12**	
	6.1.1	Earthquakes	50	2			
	6.1.2	Landslides	100	3			
	6.1.3	Volcanic eruptions	100	1			
	6.1.4	Tsunamis	100	1			
	6.1.5	Extreme temperatures	50	2			
	6.1.6	Forest fires	100	2			
	6.1.7	Drought	50	1			
	6.1.8	Floods	100	2			
	6.1.9	Storms	50	3			

	6.1.10	Avalanches	100	1			
	6.1.11	Technological hazard/Chemical plants accidents	100	2			
	6.1.12	Technological hazard/Contaminant release and explosions	75	2			
	6.1.13	Technological hazard/Radioactive contamination from nuclear power plants accidents	50	2			
6.2		Circumstances at the Site					
	6.2.1	Outdoor Air Quality	0	4			
	6.2.2	Ambient Noise Level	0	4			
	6.2.3	Soil and building plot contamination	0	4	**Not**	**Assessed**	**(not a core indicator)**
	6.2.5	Urban Heat Island Effect	0	4			
	6.2.6	Electromagnetic pollution	0	4			
6.3		**Options for Transportation**					
	6.3.1	Accessibility of the nearest railroad station	0	3			
	6.3.2	Accessibility of the nearest public local transportation stop	75	3			
	6.3.3	Availability of modern low emission transport options: city bike scheme, car club scheme, charging infrastructure for electric/hybrid vehicles, electric/hybrid bus lines	75	3	**65,38**	**2,84**	
	6.3.4	Availability of Walking and Bike Path	100	4			
6.5		Access to amenities					
	6.5.1	Vicinity to Gastronomy facilities	0	4			
	6.5.2	Vicinity to Local Supply facilities	0	4			
	6.5.3	Vicinity to Parks and Open Spaces	0	4			
	6.5.4	Vicinity to Education facilities	0	4			
	6.5.5	Vicinity to Public Administration facilities	0	4	**Not**	**Assessed**	**(not a core indicator)**
	6.5.6	Vicinity to Medical Care facilities	0	4			
	6.5.7	Vicinity to Sport facilities	0	3			
	6.5.8	Vicinity to Leisure facilities	0	2			
	6.5.9	Vicinity to Services	0	4			

8. CONCLUSION

ESH building as a representative of an apartment building was subject to sustainability assessment according to OPEN HOUSE methodology. Assessment reviled the lack of data available for this type of assessment in Slovenia, especially the data required by LCA analysis, but also the threshold values and ranking in some cases must be rechecked in future. There is currently no reference building scenario available that could be used in LCA analysis, so it was developed within this task. This reference model could be used for further development in the future.

In ESH assessment process 31 indicators (with a number of subindicators) were evaluated. Initial weighting system (from OPEN HOUSE) for Slovenia was applied.

The results showed that according to OPEN HOUSE methodology ESH reached 60,1% in environmental quality, 79,6% in terms of social/functional quality and 77,9% in terms of economic quality. Altogether ESH got 72,5% in all 3 main fields of building sustainability.

Within this task of EE Highrise project a lot of experience has been gained for all project participants. Sustainability assessment gives a great overview of project management and completed building performance and therefore provides essential information to potential building users.

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